Analysis and description of agriculture in Poland focusing in Gmina Czernikowo region

MEMORIA DEL TRABAJO FINAL DE CARRERA

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RESUMEN DE CONTENIDOS

Este documento trata de evaluar la situación actual de la agricultura en Polonia. Se analizaron diferentes aspectos de la actividad agrícola como:

- Principales cultivos
- Tipos de energía empleadas
- Tipos de explotaciones
- Manera de trabajar la explotaciones
- Temas medioambientales
- Aspectos sociales relacionados directamente a la agricultura

Se puso especial interés en el estudio de granjas locales, tratando de analizar el flujo tanto de material agrícola como de dinero. Para ello se facilitaron unos formularios que los agricultores rellenaron con los datos necesarios para poder hacer los estudios de cada granja.

Se trató de sugerir ciertas soluciones para problemas observados y a su vez se comparó la metodología y producción con otros países de la Unión Europea.

Para poder evaluar la agricultura polaca se deberá hacer un estudio de muchos aspectos, que podrán ser observados a continuación.

1. Introducción. Problemas en la agricultura polaca

1.1 Cambios históricos

Sería injusto tratar de analizar un sector importante para la economía del país, sin parar a pensar en todos los cambios que Polonia ha sufrido a lo largo de los años. Durante el siglo XX Polonia se vio envuelta en innumerables conflictos que provocaron mucha inestabilidad en el país. Durante décadas sufrió severos cambios políticos, ocupaciones y cambios en sus fronteras lo que directamente se traduce en una debilitación del pueblo polaco.

Tras la segunda guerra mundial, Polonia se transformó en un país comunista que ha perdurado hasta finales de los ochenta, concretamente hasta 1989. Aun hoy en día se pueden observar vestigios de lo que sufrió el país.

Actualmente Polonia forma parte de la Unión Europea desde 2004. Para poder acceder a la unión se tuvieron que reformar muchos sectores, entre ellos, la agricultura. Por este motivo, la agricultura polaca goza de un potencial extenso que está por explotar y que depende de la continua recuperación del país.

1.2 Tipos de explotaciones

Después de la era comunista se podían observar dos tipos de explotaciones: Explotaciones estatales y explotaciones privadas. Las explotaciones estatales o también llamadas públicas eran llevadas por importantes empresas del estado.

Según los datos, cerca del 80% de las explotaciones eran privadas por un 20% de las estatales. Pero había una gran diferencia. Las explotaciones privadas tenían una extensión media de 6,6 ha mientras que las estatales tenían una media muy por encima de las anteriores, 3140 ha. La producción era extensiva, por lo que su rendimiento no era el adecuado. Está estimado que los campos polacos solo rendían un 28% con respecto a otros estados europeos. Durante estos años los agricultores de la parte privada necesitaban a menudo de un trabajo extra para aumentar sus ingresos, que eran insuficientes si dependían de la agricultura. Sólo los agricultores y operarios de las explotaciones estatales tenían ingresos suficientes para dedicarse por completo a la agricultura.

Con el sistema comunista perdiendo su inercia, las explotaciones agrícolas estatales colapsaron. Datos a lo largo de la década de los 90 nos muestran que el empleo en las explotaciones privadas aumento cerca de un 1% mientras que el empleo en las estatales se redujo drásticamente un 93,8%.

Pese a los malos datos, se estima que el desempleo en el sector agrícola sólo aumentó un 16%, lo que nos revela la diferencia en cuanto al número de agricultores en el sector privado y el estatal o público. Como se puede observar, el sector agrícola privado, que se encontraba muy debilitado, no pudo amortiguar estos cambios, por lo que la agricultura polaca sufrió un gran golpe. Son esta clase de cambios, que ocurrieron hace relativamente poco tiempo, los que han podido suponer un hándicap para la agricultura polaca a finales del siglo XX y comienzos del XXI.

Pese a lo llamativo que son los datos, el empleo en el sector agrario sólo descendió un 16% en dicha década, lo que nos puede dar una idea de la cantidad tan superior de agricultores que existían en el sector privado frente a las explotaciones estatales. Estos datos se pueden ver resumidos en la tabla 1.

Empleo en el sector Agricola en Polonia 1988-2000				
	1988	***2000***	***Changes 1988-2000***	***% change 1988-2000***
Total	5,133,800	4,304,627	-830,173	-16.2
Ex. estatales	920,456	56,834	-863,622	-93.8
Ex. privadas	4,213,254	4,247,793	+34,539	+0.8

Tabla 1. Fuente: GUS (1990, 2001b).

Como cabe esperar, durante los años consecutivos a la caída del comunismo, las explotaciones de extensión menor a 5 ha eran la mayoría. Durante los últimos años de los 90 y principios del nuevo siglo, estos datos fueron variando como se puede observar en la tabla 2.

Ex. Agrícolas **en Polonia**			
	2003	***2005***	***2007***
Ex. Agrícolas <5ha	1,444,810	1,750,860	1,637,280
Ex. Agrícolas 5-20 ha	619,190	608,140	628,660
Ex. Agrícolas 20-50 ha	90,320	96,780	101,370
Ex. Agrícolas ≥ 50 ha	17,880	20,700	23,640
Ex. Agrícolas total	2,172,210	2,476,470	2,390,960

Tabla 2. Fuente: Eurostat

Se puede observar que el número de explotaciones de menos de 5 ha aumentó durante estos años, pero es reseñable que las explotaciones de mayor extensión aumentaron notoriamente y pese a que el aumento del número de éstas no sea algo que llame excesivamente la atención, si hay que tener en cuenta que cada una de de estas parcelas mayores, equivale al menos a 3 ó 4 veces, al menos, el tamaño de las parcelas de menor tamaño.

Para hacernos una idea mejor de la situación, sería conveniente comparar dichos números con los datos de otros países. Véanse las tablas 3 y 4.

Ejemplo de ex. Agrícolas en otros países europeos ≤ 5 ha					
	1990	**2000**	**2003**	**2005**	**2007**
Polonia	----	----	1,444,810	1,750,860	1,637,280
España	971,390	740,500	626,960	577,210	551,360
Italia	2,099,000	1,687,040	1,508,880	1,271,660	1,230,700
Alemania	218,580	117,630	97,460	88,010	83,570

Tabla3. Fuente: Eurostat

Ejemplo de ex. Agrícolas en otros países europeos ≥ 50 ha					
	1990	**2000**	**2003**	**2005**	**2007**
Polonia	----	----	17,880	20,700	23,640

España	86,980	99,900	99,950	99,670	101,190
Italia	38,370	36,540	40,400	38,620	40,010
Alemania	56,280	78,670	83,540	84,600	85,360

Tabla 4. Fuente: Eurostat

1.3 Labor agrícola

En el año 2000, el empleo en el sector agrícola suponía un 25% del grueso del empleo. Hay que aclarar que se considera trabajador en este sector a aquel que invierte 40 horas semanales en una explotación.

Como ocurre en muchos países a lo largo de un periodo de desarrollo, en los años finales de la década de los 90, el número de agricultores de menos de 35 años era ligeramente superior al de agricultores por encima de los 65 años. Con el paso de un lustro, los datos cambian pudiendo ver que la población joven tiende a abandonar el medio rural, produciéndose un descenso notable del número de agricultores menores de 35 años.

Se deduce que muchos de estos agricultores mayores de 65 años son los propietarios de las explotaciones menores de 5 ha, por lo que es posible que cuando esta generación abandone el campo, las explotaciones de mayor rango comenzarán a aumentar en mayor medida.

Datos tabulados en el trabajo principal, muestran que la mano de obra a principios de siglo XXI se componía principalmente en: los propios propietarios de la explotación que se encargan solos de ésta y ayuda de individuos de la familia. Sólo un 5% de los trabajadores en este sector son trabajadores contratados.

Debido a estos números, se comprende que la agricultura polaca era recientemente, un sector familiar donde según otros datos presentados en el trabajo final, podemos observar que muchas explotaciones obtienen producción únicamente para subsistir. Esta agricultura de subsistencia se encuentra en pequeñas explotaciones donde los medios y la extensión de la parcela no da para obtener excedentes y vender. Con el paso de esta generación es posible que se comiencen a crear con mayor intensidad cooperativas que puedan unificar la producción, así como una reordenación del territorio y quizás, nuevos inversores que unifiquen parcelas para crear una explotación.

En conclusión, como en otros países está ocurriendo o ha ocurrido recientemente, el trabajo en el campo únicamente es apetecible para la población joven que pueda encontrar en la agricultura una motivación. Dicha motivación ha de ser empleo cualificado aliado con el no cualificado, todos ellos reunidos bajo las faldas de una organización mayor que permita aumentar el nivel de producción y por supuesto, el nivel de inversión.

1.4 Tipos de explotaciones según la producción

Como bien se puede observar en el documento original, hay diferencias en cuanto a datos sobre el porcentaje de explotaciones que hay, según su producción. Escogiendo una de las fuentes de información usadas en el documento, se puede observar que hoy en día las explotaciones comienzan a ser más productivas.

Los datos más optimistas indican que cerca de un 13% de las explotaciones tienen unos ingresos y producciones bajos, es decir, agricultura de subsistencia. También encontramos que cerca de un 40% de las explotaciones obtienen un mínimo de excedente que permite obtener unos ingresos extra a parte de para subsistir. Con un 47% encontramos a las explotaciones que se consideran tienen una producción solvente. Hay fuentes de información cuyos datos varían en detrimento de las explotaciones solventes.

En general, la producción de Polonia en muchos tipos de cultivo está incrementando, llegando a ser una productora a tener en cuenta si la comparamos a otros países europeos.

1.5 Calidad del suelo

La calidad de los suelos de Polonia no es la mejor debido al sufrimiento del suelo durante épocas de glaciación. El resultado es que la superficie del país se compone de suelos ligeros de arena, un suelo permeable.

Aunque actualmente la calidad del suelo ha mejorado ligeramente, aun se puede decir que la calidad no es buena. Según datos dados por el Ministerio de agricultura polaco, se estima que la calidad del suelo sea un 25% menos productivo que el de otros miembros de la Unión.

1.6 Recursos de agua

Polonia se considera un país con bajos recursos acuáticos. Los cursos de agua son cambiantes en cuanto a volumen y no están bien distribuidos por toda la geografía. La parte central del país sufre un déficit de agua mientras que la región montañosa del sur se ven habitualmente afectadas por fuertes lluvias.

La mejor manera de cuantificar este problema es comparando la media de cantidad de agua disponible por persona y año. En el caso de Polonia, la media se encuentra en torno a 1.300

m^3/ habitante/ año, mientras que la media de la Unión Europea es de 4.500 m^3 /habitante/año.

Sería interesante poder realizar proyectos futuros de reserva de agua, ya que únicamente se conserva un 6% del agua que cae en forma de lluvia.

1.7 Problemas medioambientales

Los aspectos ambientales son siempre un punto muy interesante dentro de cualquier rama agrícola. Aunque estos problemas no están sólo directamente relacionados con las actividades agrarias, si es de gran importancia ya que la agricultura ha de tender a ser una actividad absuelta de conflictos ambientales en la medida de lo posible.

1.7.1 *Problema 1: Polución del agua*

Durante la segunda parte del siglo XX se comenzaron a usar grandes cantidades de fertilizantes con un criterio no muy estricto. Se emplearon grandes cantidades de fósforo y nitrógeno con un bajo nivel de efectividad. Los porcentajes de efectividad eran de un 30% en el caso del fósforo y del 20% en el caso del nitrógeno (Andrzej Sapek, The impact of agriculture on ground and surface water quality in Poland).

No sería justo decir que este uso se dio en todas las zonas del país, pero si en lugares como Poznan, Leszno, Kalisz, Konin, Wloclawek, Bydgoszcz y Torun.

Se hicieron comparaciones entre las regiones citadas y otros países europeos y los resultados fueron similares en cuanto a niveles de nitrógeno, pero muy superiores en cuanto a niveles de fósforo. Al menos un 50% de los suelos del país tienen un alto o muy alto nivel de contaminación de fósforo. Este hecho pone en serio peligro la calidad del agua.

La contaminación de recursos acuáticos debido a un exceso de uso de fertilizantes no sólo depende de la cantidad de producto empleado, sino de la calidad de este mismo y de la capacidad del suelo para retener dichos productos.

A pesar de que los datos de contaminación de aguas no son exactamente buenos, hay que hacer otra observación y es que el uso de fertilizantes está aumentando en Polonia. Esto se puede deber a la calidad de los suelos añadido a los aumentos de producción de los últimos años. Se debería poner especial atención a la calidad de los productos y emplear los adecuados.

Como bien se ha descrito en el apartado de recursos de agua, este elemento escasea en ciertas zonas, por lo que será de gran importancia en un futuro próximo el regular el uso de ciertos productos y concienciar al agricultor en el uso correcto de fertilizantes.

1.7.2 *Problema 2: Fuentes de energía y energías renovables*

Este apartado está claramente relacionado no sólo con el sector agrario sino con demás sectores. No obstante es de importancia hacer hincapié en un uso de energías limpias en agricultura.

Según datos obtenidos de la revisión de la política de energías renovables de Polonia llevada a cabo en 2005, sólo un 5% de la energía empleada en el país procedía de energías renovables. Un 50% proviene del carbón. Ejemplos de los países más adelantados en estos campos como EEUU nos muestran que existen explotaciones donde parte de la energía empleada provienen de fuentes propias de energía renovable. El ejemplo estadounidense ha de servir únicamente como un ejemplo del posible manejo de estas energías en las explotaciones polacas. Hoy en día, y no sólo en Polonia, esta manera de gestionar la energía se escapa a las posibilidades de la mayoría de los agricultores. Todavía es demasiado cara y en el caso de Polonia, por lo anteriormente explicado, se puede entender incluso fuera de contexto hasta que su agricultura no se desarrolle más y se reduzcan las explotaciones de bajo rendimiento.

Tras la entrada de Polonia en la Unión Europea, este país acordó poner en marcha programas de desarrollo de energías limpias y reducir las emisiones a la capa de ozono. Gracias a estos programas, comienzan a brotar estas energías en Polonia.

La región de Kujawsko-Pomorskie, lugar donde se analizarán las explotaciones agrícolas en este trabajo, es una de las regiones con mayor producción de energías renovables.

a) *Energía eólica*

La región del estudio, Kujawsko-Pomorskie, es un lugar idóneo para la instalación de molinos de viento. Esto se debe a que las condiciones en las que sopla el viento son muy favorables y una de las regiones con mejores registros en cuanto a viento se refiere.

Ahora mismo debería de haber más de 96 plantas y cada año aumentan en número. La meta de los programas llevados ahora a cabo quieren alcanzar los 2.540 MW de energía teórica.

No obstante y como consecuencia de ser una energía incipiente, algunos de los nuevos inversores se están viendo en problemas de cara a poder dar una buena conexión desde las plantas a la red eléctrica sin problemas de sobrecarga.

b) *Energía hidráulica*

La energía hidráulica es una de las más importantes dentro de las energías renovables en Polonia.

En esta región donde se ha realizado el trabajo, encontramos 103 plantas de energía hidráulica. Todas ellas las encontramos en los cursos de los ríos, y en presas de diversos tamaños.

Un 70% se encuentran en los cursos de los ríos y un 20% en presas. El 10% restante se encuentra distribuido en otras clases de cursos de agua.

Hay muchos planes de inversiones futuras en esta región. Hasta el año 2015 se tiene proyectada la implantación de 528 nuevas plantas y parece que este número aumentará con el paso del tiempo. El problema de la energía hidráulica es que es un poco más cara que la energía eólica. De esta manera, es más difícil encontrar inversores o reunir suficiente dinero para una nueva inversión. Los datos son claros: un 90% de las personas que han invertido en energía eólica tienen planes u otros proyectos para volver a invertir. En el caso de la energía hidráulica los datos son distintos. Sólo un 60% de los inversores volverán a embarcarse en planes de tal energía.

c) *Biomasa*

La biomasa es un método de obtención de energía muy empleado en la región del estudio. Hay muchos cultivos que se emplean para obtener energía. Por ejemplo, existen cerca de 52 ha de maíz con este propósito. El cultivo más importante es el de la colza, y en este caso, se destinan cerca de 2.500 ha para biomasa. Otros cultivos de menor extensión son: triticale de invierno (31,8 ha), avena (14,7 ha), remolacha azucarera (2,1 ha).

Hay 7 plantas de biogás y 4 plantas de producción de biofuel entre otros muchos tipos de plantas de producción.

Sin embargo, hay una continua discusión sobre el tema de la biomasa, y es que muchos científicos temen este método de obtener energía. La principal razón es que estamos usando el mismo cultivo para alimentar a la población o para producir energía. En algunos lugares del mundo la producción que podría ir destinada a alimentación se podría estar usando para fines energéticos, debido en gran parte a que quizás se pague mejor el kg de producción.

Otro gran problema es la eliminación de bosques y selvas para poder obtener mayor cantidad de terreno. Este problema se está haciendo patente hoy en día en Brasil. En lugares donde la regulación de la actividad agrícola no es demasiado estricta, se dan casos en los que agricultores talan regiones forestales o selváticas para obtener mayor parcela disponible para

aumentar su producción. Hay muchos casos conocidos en los que el fin de estas acciones es el aumento de producción con fines energéticos.

Muchos otros científicos defienden el uso de cultivos para la obtención de energía pero basándose en unas reglas:

a) Podemos usar cultivos en los que no haya una competición de precios que pueda desequilibrar el mercado.
b) Se pueden usar residuos de cultivos como pueden ser de cereales, entre otros.
c) Se podría usar madera siempre que provenga de bosques sostenibles con este fin.
d) Se podría sacar provecho a aquellos productos que son excedentes del sector industrial, siempre y cuando no sean contaminantes.

En general, en Polonia se comienzan a introducir las energías renovables, pero aun hay que dar más margen de tiempo pues este país sigue dependiendo en gran medida de la extracción de carbón. El sector energético es importante, pero menos que en otros países, donde la electricidad se emplea en más ámbitos. Por poner un ejemplo, la mayoría de las cocinas son de gas mientras que por ejemplo en España, la electricidad ya se impuso hace tiempo. Hoy por hoy, el uso de energías fósiles es muy elevado en Polonia, pero los proyectos que van surgiendo y el apoyo que van ganando las energías limpias en la Unión Europea hacen ser optimistas. Es un país donde los recursos ambientales son potencialmente buenos para desarrollar este campo.

2. Principales cultivos de Polonia

En este apartado del estudio hay una descripción de todos los principales cultivos de Polonia y también unas comparaciones en cuanto a producciones con otros países de la Unión Europea.

2.1 Producción de cereal

La producción de cereal en Polonia durante los últimos 30 años ha ido incrementándose. Este dato es de importancia pues la producción es más que suficiente para el autoabastecimiento.

La producción de cereal de Polonia se encuentra en torno a las 28 millones de toneladas por año. Estos datos son sólo superados por Francia y Alemania que poseen una producción mucho más alta. España se encuentra a una media de 5 millones de toneladas por debajo de Polonia.

Todos los comentarios aquí realizados vienen fundamentados con gráficas en el estudio.

2.2 Producción de colza

La colza es un cultivo muy típico de la zona norte de Europa. Su producción viene directamente relacionada con el aceite de colza.

El uso de aceite de oliva en regiones mediterráneas provoca que las producciones sean realmente distintas por ejemplo entre España y Polonia. La producción de colza de España en 2010 fue de 35000 toneladas, mientras que la producción polaca estuvo en 2 millones de toneladas.

Como en el caso del cereal, Polonia se encuentra en el tercer lugar solamente tras Alemania y Francia. Según datos de soyatech.com, Polonia fue la sétima productora de aceite de colza a nivel mundial. La producción está aumentando ligeramente año tras año y parte de la culpa de este aumento puede ser explicado por la producción de biodiesel.

No obstante, el aceite de oliva comienza a ganar terreno en el mercado, en parte, porque es en varios aspectos más saludable.

2.3 Producción de remolacha

La remolacha es un cultivo de gran importancia en Polonia. Pese a que la producción había decaído de manera general en toda Europa, podemos encontrar datos de FAO en el que Polonia era el quinto país del mundo en cuanto a producción, con un 4,55% de la producción mundial.

2.4 Producción de patata

Polonia es un país extremadamente fuerte a la hora de producir patata. Una de las características de esta alta producción es que un elevado porcentaje de ésta se concentra en pequeñas explotaciones. La distribución exacta viene explicada en el estudio. Como he podido comprobar en persona, en Polonia el mercado de la patata "en fresco" es muy habitual, pudiendo encontrar en los grandes supermercados patatas de reciente cosecha, las cuales es necesario ser incluso lavadas para eliminar restos de tierra. Algo inusual en otros países como en España.

Según datos de Faostat, Polonia fue hasta hace poco, la sexta productora de patata a nivel mundial. Pero como en otros muchos cultivos, la tendencia es a bajar debido a que la producción se está trasladando a escala mundial a países de América del Sur y principalmente a China.

Como curiosidad cabe decir que la media productora de Europa es de 17,4 toneladas por hectárea mientras que en algunos sistemas avanzados de EEUU se han alcanzado rendimientos de 41,2 toneladas por hectárea.

2.5 Producción de zanahoria

Este es un cultivo en el que Polonia es líder europeo indiscutible. Según Faostat, en 2009 Polonia produjo 935.000 toneladas. Solamente Reino Unido, Francia e Italia consiguen acercarse a esta producción y aún así no pasaron de 680.000.

Pese a los buenos datos de producción, encontramos una bajísima eficiencia en el cultivo de la zanahoria polaca. Los rendimientos conseguidos son muy bajos por tonelada llegando a ser casi la mitad que otros países productores. En Polonia se produjo en 2009 y según Faostat, 28,33 toneladas por hectárea, cuando países como Reino Unido consiguen rendimientos de 68,52 toneladas por ha.

La falta de mecanización y de riego en ciertos estadios de la planta pueden provocar estos problemas, como bien han podido demostrar ciertos estudios llevados a cabo en campos polacos.

2.6 Producción de manzana

Dentro del ámbito de la fruticultura, el fruto de mayor producción en Polonia es la manzana. La producción de manzana representa cerca de un 80% de la producción total de fruta del país. Debido a que Polonia es una de las mayores productoras de manzana de Europa, no es de extrañar que su producto se pueda ver exportado fácilmente a países del norte de África, como Marruecos, Túnez y Algeria. La exportación de manzana polaca es de gran interés para muchos países debido a que la producción de manzana en Polonia es más barata que en Alemania, por lo tanto los precios son menores.

Un campo de gran interés para la industria agroalimentaria polaca es la producción de zumo concentrado de manzana. Polonia es la segunda por detrás de China y por delante de EEUU en la elaboración de dicho producto.

Como bien se puede observar en las gráficas y tablas del estudio, Polonia produjo en 2010, cerca de los 2 millones de toneladas, mientras que Alemania produjo 835.000 toneladas. Estos datos nos hacen imaginar la amplitud de este mercado para Polonia.

Sin embargo, se ha podido observar durante el tiempo de estudio, la falta de asociación de productores en cooperativas para todos los cultivos y la ausencia de denominaciones de origen. Una buena denominación de origen para las manzanas producidas en Polonia podría suponer ampliar seriamente el mercado internacional y un aumento de ingresos. Todo esto requiere una fuerte inversión y una serie de pautas a seguir por parte de los productores en todos los aspectos. Hoy en día, el tema de organizarse en cooperativas no está ni mucho menos instaurado en muchas zonas de Polonia por lo que la idea de organizarse bajo una "marca" es todavía remota en algunas zonas de Polonia.

2.7 Producción en invernadero

La producción en general en invernadero es un tema que suscitaba cierto interés a la hora de realizar este trabajo. Hay que tener en cuenta que en este estudios se refiere a invernaderos de cristal

El interés venía suscitado por la complejidad del clima en Polonia y porque a priori, no se encontraban invernaderos fácilmente. Una de las principales razones es por el caro mantenimiento en un país donde se puede ver nieve continuamente durante hasta 4 meses.

Los últimos años, la superficie cultivada bajo invernadero ha ido disminuyendo en gran medida y aun así, Polonia sigue siendo uno de los países de la Unión Europea con mas invernaderos. Es importante hacer hincapié en que los datos son de invernaderos de cristal. Esto es importante porque en España, por ejemplo, la extensión de cultivos bajo invernadero es mucho mayor que la de Polonia, pero claro está que en España, debido al clima, la instalación de invernaderos de cristal no es en muchos casos necesaria y se opta por el plástico.

En el caso de Polonia, los invernaderos de cristal tuvieron un crecimiento los primeros años del siglo XXI. Se usaban primordialmente para el cultivo de tomate, lechuga, etc… Pero al cabo de cierto tiempo se pudo observar que no era rentable y muchos de estos invernaderos se destinaron a otro tipo de agricultura.

Muchos productores comenzaron a dedicarse al cultivo de flores. Este mercado sufrió entonces un gran crecimiento y se producían un 400% más de flores que en los años 70.

El 70% de la producción de flores corresponde a invernaderos privados de un área comprendida entre los 500 y 2000 m^2.

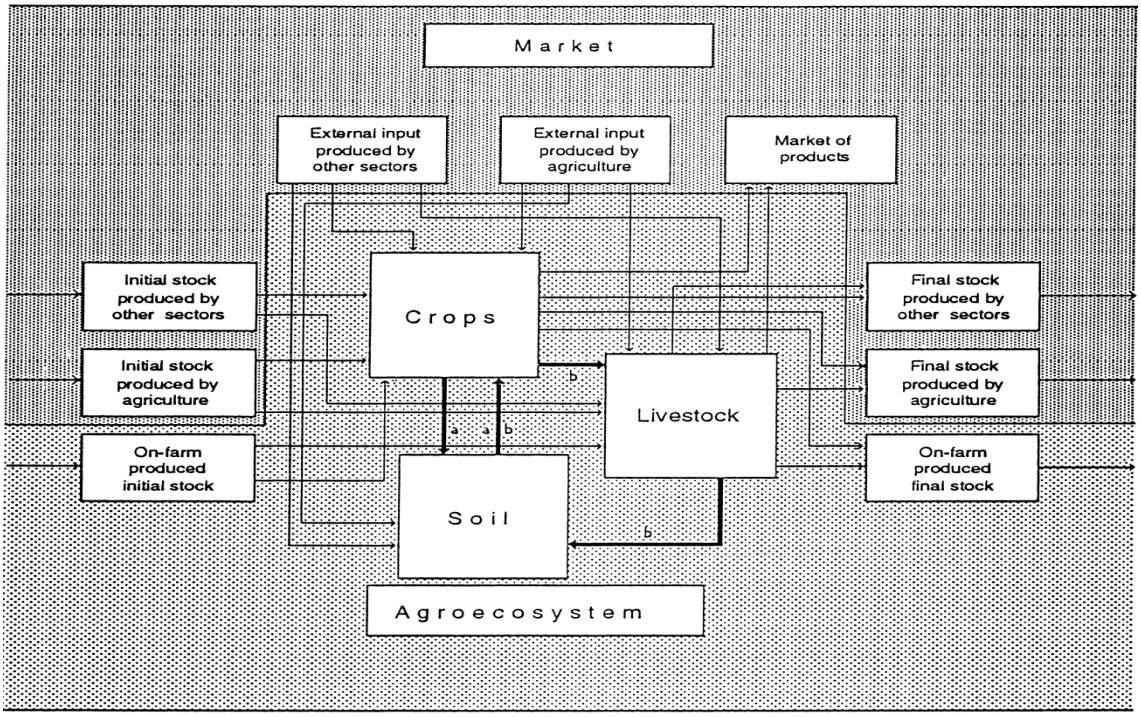
Los datos confirman que existen en torno a 1.800 ha de cultivo bajo invernadero de cristal equipado con sistemas de calefacción y como apunte, la superficie de invernaderos de plástico no supera las 2000 ha. En España en el año 2009 se contaban en torno a 58000 ha bajo invernadero y un gran porcentaje de estos son de plástico. El poder cultivar en invernadero de plástico es una ventaja propiciada por el clima y en Polonia el clima es destructivo en invierno.

3 Métodos y enfoque científico

El verdadero final de este trabajo es el poder hacerse una idea de la agricultura polaca de una manera directa. Es por eso que en este trabajo hay una labor de búsqueda de información en artículos relacionados con Polonia y también una serie de encuestas o formularios diseñados para obtener la información necesaria y así poder desarrollar el modelo que será resumido a continuación.

Para la realización del modelo se empleará como ejemplo el diseñado por V. Tellarini y F.Caporali.

3.1 Modelo del funcionamiento de una explotación



Representación espacio temporal de un agroecosistema. V. Tellarini, F. Caporali

Se empleó este modelo de cara a poder analizar el flujo de materia y de energía a través de las granjas polacas que estudiamos. Para un mejor entendimiento del modelo, se procederá a una explicación breve.

Podemos dividir la circulación total en dos:

- Circulación pequeña (a)
- Circulación grande (b)

Como punto de paso de esta circulación podemos encontrar tres puntos importantes que son:

- Cultivos
- Animales
- Suelo

La circulación pequeña comprende la circulación de materia entre cultivos y suelo y la circulación larga comprende el flujo de materia entre cultivos, animales y suelo.

Mediante este método se consigue obtener cuanta materia entra en el circuito y cuanta sale, así ocurre también con el flujo de energía. Gracias a los formularios rellenados por los agricultores se pudo obtener información de semillas, animales, fertilizantes, etc… Se ha de hacer el apunte de que en la mayoría de las explotaciones polacas es imposible hacer un análisis de la producción vegetal sin tener en cuenta la producción animal pues prácticamente la totalidad de ellas eran explotaciones mixtas.

Gracias a los datos obtenidos de los formularios y a unas tablas de conversión de las unidades de materia a unidades de energía, pudimos introducir los datos obtenidos en el modelo y simular el recorrido de materia y energía a lo largo del cuadro.

En estas circulaciones debíamos de tener datos de cómo procedía a trabajar el agricultor, es decir, de cómo utilizaba el estiércol, de cuánto grano usaba para alimentar a los animales y cuánto compraba.

Como se puede observar en el cuadro, hay una serie de aportaciones que provienen de fuera de la explotación como pueden ser fertilizantes, semillas compradas, animales comprados, etc… y también aportaciones que provienen de la misma explotación y que son reusados.

3.2 Materiales y protocolo

Se llevó a cabo el estudio de 19 explotaciones de la región Kujawsko-Pomorskie. Como antes se ha explicado, se emplearon unos formularios y en el caso de este estudio, se tratará de hacer hincapié a la hora de analizar los resultados únicamente en el apartado de producción vegetal.

En el estudio podremos encontrar tablas de conversiones para todos los aspectos y descripciones detalladas de cada granja, con localización por satélite, coordenadas, datos sobre los propietarios y número de trabajadores. Producción primaria, secundaria, labor del agricultor en horas por año y demás información necesaria para el análisis de cada explotación.

4 Resultados

En el apartado de resultados encontramos los modelos de circulación de materia y energía. Los datos de flujo de materia vendrán señalados en un modelo mientras que el flujo de energía de la misma explotación se podrá ver en otro modelo en la misma página. Encontraremos tantos cuadros o modelos como explotaciones hayan sido estudiadas.

Con los datos recogidos se pueden observar los aportes desde el exterior de la explotación y los aportes que proceden desde la misma. De esta manera, es posible vislumbrar, entre otras cosas, la sostenibilidad de las explotaciones.

Así mismo, se podrán observar los resultados de los cuestionarios rellenados por los agricultores. Se muestran de manera tabulada de manera que las comparaciones son más sencillas.

Dichas tablas resumen datos de campos como: semillas, fertilizantes, cultivos, protección de cultivos, combustibles, labor humana y demás información recolectada.

Estos resultados dieron pie a las conclusiones y discusión de los siguientes apartados.

Semillas:

	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Farm 6	Farm 7	Farm 8	Farm 9	Farm 10	Farm 11	Farm 12	Farm 13	Farm 14	Farm 15
Propio															
Kg/ha	134,9	121,18	81,68	70	74,79	164,3	152	67,31	114,55	41,54	118,88	72,07	75,36	20,55	11,11
Gj/ha	2,18	1,99	1,31	1,13	1,23	2,69	2,49	1,07	1,89	0,67	1,92	1,19	1,21	0,33	0,19
Comprado															
Kg/ha	0	0	38,46	80,32	54,35	0	0	76,92	0	40,5	39,63	36,94	95,65	71,2	69,05
Gj/ha	0	0	0,63	1,35	0,87	0	0	1,27	0	0,66	13,88	0,6	1,49	1,66	1,26

Fertilizantes:

	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Farm 6	Farm 7	Farm 8	Farm 9	Farm 10	Farm 11	Farm 12	Farm 13	Farm 14	Farm 15
Fertilizantes minerals															
Nitrogeno															
Kg/ha	33,37	85,15	174,15	62,78	54,22	30,24	186,67	44,13	47,12	25,24	69,16	103,59	46,09	48,62	124,76
Gj/ha	2,93	7,48	15,31	5,52	4,77	2,66	16,41	3,88	4,14	2,22	6,08	9,11	4,05	4,27	10,97
Fósforo															
Kg/ha	13,71	14,69	71,20	60	3,22	0,36	40	10,15	21,72	16,36	0	28,83	0	10,17	*38,1*
Gj/ha	0,36	0,39	1,88	1,58	0,09	0,01	1,05	0,27	0,57	0,43	0	0,76	0	0,27	*1*
Potasio															
Kg/ha	20,57	14,69	106,8	60	4,84	0,54	60	10,15	32,57	24,54	0	59,46	0	15,26	57,14
Gj/ha	0,22	0,15	1,12	0,63	0,05	0,01	0,63	0,11	0,34	0,26	0	0,62	0	0,16	0,6
Magnesio															

Kg/ha	0	0	0	0	0	0	0	0	0	0	0	87,57	0	0	0
Gj/ha	0	0	0	0	0	0	0	0	0	0	0	0,12	0	0	0
Calcio															
Kg/ha	0	0	0	0	0	0	0	0	0	0	0	16,22	0	0	0
Gj/ha	0	0	0	0	0	0	0	0	0	0	0	0,02	0	0	0
Fertilizantes naturals															
Nitrogeno															
Kg/ha	57,14	12,24	20,59	59,45	0	0	2,67	57,69	77,36	2,6	54,03	0	36,23	30,52	47,62
Gj/ha	5,02	1,08	1,81	5,23	0	0	0,23	5,07	6,8	0,23	4,75	0	3,19	2,68	4,19
Fósforo															
Kg/ha	14,86	3,18	5,35	31,20	0	0	0,69	15	20,11	0,68	14,05	0	9,42	7,93	12,38
Gj/ha	0,39	0,08	0,14	0,82	0	0	0,02	0,40	0,53	0,02	0,37	0	0,25	0,21	0,33
Potasio															
Kg/ha	66,29	14,20	23,8	64,17	0	0	3,09	66,92	89,74	3,01	62,68	0	42,03	35,4	55,24
Gj/ha	0,69	0,15	0,25	0,67	0	0	0,03	0,7	0,94	0,03	0,66	0	0,44	0,37	0,58
Magnesio															
Kg/ha	0	0	0	49,78	0	0	0	0	0	0	0	0	0	0	0
Gj/ha	0	0	0	0,07	0	0	0	0	0	0	0	0	0	0	0
Calcio															
Kg/ha	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0
Gj/ha	0	0	0	0,02	0	0	0	0	0	0	0	0	0	0	0

Protección de cultivos:

	Farm 1	**Farm 2**	**Farm 3**	**Farm 4**	**Farm 5**	**Farm 6**	**Farm 7**	**Farm 8**	**Farm 9**	**Farm 10**	**Farm 11**	**Farm 12**	**Farm 13**	**Farm 14**	**Farm 15**
Herbicidas (l)															

L/ha	1,94	0,98	1,56	3,2	0,61	1,64	2,84	1,98	--------	3,7	2,74	0,9	0	0,9	1,24
Gj/ha	0,51	0,26	0,41	0,84	0,16	0,43	0,75	0,52	--------	1,31	0,72	0,24	0	0,24	0,33
Herbicidas (kg)															
Kg/ha	0,02	0	0,015	0	0,2	0	0,01	0,07	--------	0,97	0	0	0,13	0,01	0,06
Gj/ha	0,01	0	0,005	0	0,05	0	0	0,02	--------	0,34	0	0	0,04	0	0,02
Fungicidas															
Kg/ha	0	0	2,3	0,16	0	0	0,47	0,54	--------	0	0	0	0	0	0,08
Gj/ha	0	0	0,27	0,02	0	0	0,05	0,06	--------	0	0	0	0	0	0,01

Cultivos:

	Farm 1	**Farm 2**	**Farm 3**	**Farm 4**	**Farm 5**	**Farm 6**	**Farm 7**	**Farm 8**	**Farm 9**	**Farm 10**	**Farm 11**	**Farm 12**	**Farm 13**	**Farm 14**	**Farm 15**
Comprado															
Kg/ha	0	0	0	0	270,8	0	732,53	0	12.486,43	64,91	0	14.150,63	947,82	558,84	219,05
Gj/ha	0	0	0	0	4,6	0	11,85	0	206,03	1,1	0	244	15,94	9,04	3,74
Propio															
Kg/ha	5.697	6.493,2	0	8,169.6	6.105,7	6.719	8.397,33	9.506,69	3.132,46	3.866,02	6.801,15	288,28	1.303,3	7.423,46	7.303,2
Gj/ha	92,002	105,02	0	131,1	76,2	108,46	133	153,05	50,75	48,81	110,22	4,73	16,8	99,88	86,5
Para vender															
Kg/ha	0	0	9.544,9	0	0	0	0	0	0	1.616,25	0	0	0	0	0
Gj/ha	0	0	171,51	0	0	0	0	0	0	30,45	0	0	0	0	0
Forraje															
Kg/ha	0	0	3.173,86	0	0	0	0	0	0	0	0	0	0	0	0
Gj/ha	0	0	51,18	0	0	0	0	0	0	0	0	0	0	0	0

Combustibles:

	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Farm 6	Farm 7	Farm 8	Farm 9	Farm 10	Farm 11	Farm 12	Farm 13	Farm 14	Farm 15
Diesel															
l/ha	114,3	42,84	0,82	120	77,37	109,17	133,33	96,15	135,72	90,87	78,17	90,09	101,45	101,72	19,05
Gj/ha	5,46	2,05	0,04	5,73	3,7	5,21	6,37	4,6	6,5	4,34	3,73	4,3	4,85	4,86	0,91
Oil															
l/ha	0,57	3,06	1,17	4	6,6	10,92	1,4	1,15	0	2,07	4,75	0,9	2,9	1,07	0,95
Gj/ha	0,03	0,15	0,05	0,2	0,31	0,521	0,07	0,05	0	0,099	0,22	0,04	0,14	0,05	0,04
Gasolina															
l/ha	57,14	0	11,7	0	0	0	2,7	1,9	0	12,98	57,64	0	0	2,03	0
Gj/ha	2,73	0	0,55	0	0	0	0,13	0,09	0	0,6	2,75	0	0	0,09	0

Labor humana:

	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Farm 6	Farm 7	Farm 8	Farm 9	Farm 10	Farm 11	Farm 12	Farm 13	Farm 14	Farm 15
Gj/ha	0,25	0,54	0,06	0,25	0,18	0,27	0,11	0,13	0,45	0,13	0,21	0,08	0,21	0,08	0,22

Electricidad y otros:

	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Farm 6	Farm 7	Farm 8	Farm 9	Farm 10	Farm 11	Farm 12	Farm 13	Farm 14	Farm 15
Electricidad (Gj/ha)	1,3	0	0	0	6,02	3,96	0,97	13,82	4,99	1,24	8,63	1,3	2,7826	0,74	7,13
Maquinaria (Gj/ha)	1,8	4,1	1,7	4,1	5,59	3,6	1,26	2,73	3,2	2,68	4,22	1,77	4,39	0,77	1,32
Gas (Gj/ha)	0	0,51	0,1	0,22	0	0	0	0	4,59	0	0	0	0	0	0
Madera(Gj/ha)	2,65	4,53	1,62	3,71	8,96	10,11	2,47	0	12,57	0,6	0	8,34	71,01	1,88	0,74
Carbón(Gj/ha)	4,2	5,12	0,98	1,67	20,24	3,43	1,12	0,81	0	0,27	9,05	0	3,03	0,85	1,66

5 Discusión

Semilla

En este apartado se comentan los resultados de manera subjetiva sobre la manera de actuar de los agricultores de cada explotación. Como se puede ver en los resultados, 5 de los 15 agricultores no compran semilla. Se valen de su propia semilla obtenida el año anterior. El resto de explotaciones compran semilla en mayor o menor medida. Algunos de ellos compran una cantidad similar a la propia obtenida y la combinan. Otros como las explotaciones 14 y 15 compran mucha más semilla de la que obtienen el año anterior.

Algunas explotaciones, se entiende pues, son auto suficientes en cuanto a semilla empleada. Esto es bueno siempre y cuando se tenga cuidado con que cultivo se haga y teniendo en cuenta que no decaiga el rendimiento con el paso de un par de años. Sería conveniente renovar el material cada cierto tiempo y a ser posible, aumentar el rendimiento mejorando las labores de campo.

Fertilizantes

En este punto es importante remontarse a la información sobre la calidad del suelo. El uso de fertilizantes inorgánicos de nitrógeno es elevado. Se ha de inculcar poco a poco que el uso de ciertos elementos como el nitrógeno, pasan del suelo a cursos subterráneos de agua en forma de nitratos, bajando la calidad de ésta. Es un tema a tener en cuenta debido a que el mar Báltico, que recoge los cauces de la mayoría de los ríos polacos, ha mostrado niveles altos de contaminación.

Muchas de las explotaciones son mixtas, por lo que es normal el uso de fertilizantes orgánicos como puede ser el estiércol. Sólo en tres explotaciones no se añaden fertilizantes naturales y es en parte debido a que son las únicas explotaciones sin producción animal.

La adición de fósforo tanto de manera inorgánica como orgánica ha de ser controlada por los mismos motivos que el nitrógeno. Varios estudios, alguno nombrado en el estudio, muestran como a finales de los 90 los niveles de fósforo en cursos de agua era elevado.

En cuanto a la adición de potasio, en casi todas las explotaciones se aporta de manera natural con el estiércol. En este caso los niveles han de ser altos pues el potasio es un elemento que es susceptible de ser lavado fácilmente del suelo debido a lluvias. Este es un problema y más sabiendo que el suelo de Polonia es en gran medida arenoso.

Otros elementos como el magnesio y el calcio llaman la atención por su ausencia. Este punto es importante ya que estos elementos son necesarios para obtener un buen rendimiento y aumentar la producción.

En el estudio principal se concreta más sobre estos puntos de manera individual en cada explotación.

Protección de cultivos

El uso de herbicidas, sobre todo líquidos, está muy extendido. No obstante, el uso de fungicidas e insecticidas no es, al menos en las explotaciones estudiadas, muy normal. Es posible que la falta de estos productos se deba a que ese año el tiempo fue extremadamente frío y sin muchas lluvias, por lo que no se dieron las condiciones propicias para que enfermedades, hongos y plagas fueran de importancia.

Llama mucho la atención que Polonia es un país muy plano y por ello no existen prácticamente barreras naturales entre muchas regiones como pueden ser montañas. En este caso, los bosques, muy abundantes, realizan este trabajo. Ausencia total de separación entre parcelas en forma de barreras artificiales, como podría ser una fila de árboles u otro tipo de barreras.

En las explotaciones se podrán observar las diferencias de cantidades y en ciertos casos en los que se usa en mayor medida es debido a que esa explotación se dedica en gran medida a la producción vegetal. Es de interés observar las cantidades de producto empleado en explotaciones cuya producción se centra en animales. En algunos de estos casos podremos observar altos niveles de dichos productos.

Cultivos

La producción de cultivos es muy diferente a la producción de un país como España, ya que las explotaciones son mixtas en gran medida. Son raras en esta región las explotaciones que se dedican únicamente a la producción vegetal.

Esto se debe a dos razones:

- La demanda de carne ha aumentado en Polonia los últimos años.
- Los inviernos en Polonia pueden ser excesivamente largos, cubriendo los campos de nieve durante casi 4 meses. Por ello, las labores en producción vegetal se ven muy reducidas y este tiempo se invierte en la producción animal.

Combustibles

El uso de combustibles en una explotación no sólo incumbe al uso en campo sino también en el uso doméstico. Los datos de las explotaciones donde la dedicación es completa a la

producción vegetal muestran que se emplea mucho menos combustible que en una producción mixta.

Labor humana

En este caso, la labor humana depende directamente de lo mecanizada que sea la explotación y estas diferencias se pueden observar en las tablas de resultados. También se pueden asumir errores por parte del agricultor a la hora de estimar el tiempo dedicado.

Electricidad y otros

Algunas explotaciones tienen un consumo alto de gas y de electricidad, lo que es normal hasta cierto punto. Lo importante es que hay explotaciones en donde la fuente de energía principal es carbón y madera. El uso de carbón debe ir reduciéndose gradualmente pues no es compatible con una agricultura limpia. Los datos exactos se encuentran en el documento original.

6 Conclusiones

a) La agricultura polaca está creciendo y desarrollándose, sin embargo, es necesario que se lleven a cabo cooperativas. Este tema es muy desconocido en las zonas donde se realizó el estudio.

b) La aparición de denominaciones de origen podría ser interesante de cara a mejorar la venta del producto de manera nacional e internacional.

c) La educación del agricultor comienza a ser mayor, como en otros países. En sus manos está el conocer los riesgos de no promover una agricultura sostenible y de ellos depende el cambio.

d) Polonia y en concreto su gobierno debería promover y ayudar a aquellos proyectos o explotaciones que se decidan a llevar a cabo una agricultura sostenible. Si esta clase de explotaciones pudiera aumentar sería muy bueno para el medio ambiente, para reducir la contaminación en ríos. Sin embargo, me preocupa que los productos de estas explotaciones no tengan una buena salida comercial en Polonia por el precio de estos mismos.

e) Polonia debería expandir su comercio exterior y comenzar a exportar en mayor medida.

f) Sería bueno que los agricultores polacos dejasen el modelo de producción mixta para poder centrarse en un tipo de producción y aumentar la calidad de su producto.

g) El tema de las energías es un tema pendiente en muchos países y entre ellos está Polonia, así que hay que impulsar la implantación de mas plantas de energía sostenible.

Analysis and description of agriculture in Poland focusing in Gmina Czernikowo region

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Abstract:

This research tries to evaluate actual situation of agriculture in Poland. We are going to analyse several aspects of this activity as the main crops we can find in this country, kind of energy employed, types of farms, way of working in farms, environmental issues directly related with agriculture, and more topics that will be developed in this document.

We have special interest in studying local farms, flow of inputs and outputs, methodology of their agriculture holders, etc. For this reason some holders were asked to answer a survey which is going to give us an approximate idea of local farm´s operation. These surveys will be analyzed through excel sheets.

We will try to obtain solutions and also if it is possible to compare methodology of polish farmers with data from other countries.

This research starts analyzing the most important problems of polish agriculture.

1 Introduction: Problems in Polish agriculture

1.1 Historical changes

It is so important to pay attention in the closest history of this country. Poland was involved in last XX century in many conflicts. This turned Poland as a country that was always in the middle of many political changes and modifications of its borders. After second war world which left the country and its population seriously damaged, communism was installed in Poland until 1989 and all this changes weakened Poland in some aspects.

Nowadays Poland is a member of European Union since 2004, and also this accession assumed several changes.

Polish agriculture changed so much after this period and now is still developing but there are few aspects that should be mentioned in this research.

1.2 Types of farms

After communist era, we could find two kind of different farms. There were farms called state farms and private farms. Public farms were farms managed by large enterprises from state.

There were 2 million of farms and at least 5 million of farmers. Nearly 20% of farms were state farms and 80% were private farms. State farms had a large average length of 3140 ha while private farms were small with an average length of 6,6 ha.

This was a problem because all this agricultural holdings were extensive, which means low production and also low level of employment. If we compare productivity per ha, we can see that in Poland was only reached the 28% of the average productivity of other EU members.

Most of the farmers needed an extra way of getting inputs so in these days it was a normal phenomenon to find many farmers who had another job besides theirs. Only people who worked in state farms could have enough inputs to live without an extra job.

In the period between 1990 and 2000 it took place a big change. State farms collapsed. That means that employ in agricultural public sector decrease 93.8% while employ in private sector grew up 0.8%. As we can observe in table 1, at the beginning of 90´s there were more than 900,000 employees in public sector but in 2000 we could find only 56,834 employees. These changes are always something difficult to assimilate for any sector but for agriculture one is more difficult because it is very often slower than others.

In general terms, employment in agricultural sector decreased 16% in this period of time.

Agricultural employment 1988-2000				
	1988	***2000***	***Changes 1988-2000***	***% change 1988-2000***
Total	5,133,800	4,304,627	-830,173	-16.2
Public sector	920,456	56,834	-863,622	-93.8
Private sector	4,213,254	4,247,793	+34,539	+0.8

Table 1. Source GUS (1990, 2001b).

Some people like Hunek, interviewed in 2000 by Warsaw Voice, said: “We have said good bye to the polish peasant, the social category of the peasantry, for whom farming was a way of life, it´s already gone for good”. During this decade only private sector grew up and we only could see a small increase of 2.4% in farms of more than 15 ha (6.1%-8.5%) and we could check a bigger increase in the percentage of farms with less of 2 ha of length. This increase was of 5% so it was confusing if we compare with Hunek commentary. As we can see, amount of small farmers were increasing.

In recent times we can see that this data are changing and we can see that polish agriculture is being developing.

Agricultural holdings in Poland			
	2003	***2005***	***2007***
Agri. holdings <5ha	1,444,810	1,750,860	1,637,280
Agri. holdings 5-20 ha	619,190	608,140	628,660

Agri. holdings 20-50 ha	90,320	96,780	101,370
Agri. holdings ≥ 50 ha	17,880	20,700	23,640
Total agri. holdings	2,172,210	2,476,470	2,390,960

Table 2. Source Eurostat

Nowadays we can see that agricultural holdings are changing. In 90´s decade until 2005 it is possible to check that farms with a length below 5 ha were increasing. In 2007 these small farms began to decrease in the absence of bigger farms. This is something normal and it is also happening in other countries of the EU. In table 3 is possible to see how small farms have been decreasing last two decades in another members of EU like Spain, Italy or Germany.

Example of European countries agriculture holdings ≤ 5 ha					
	1990	**2000**	**2003**	**2005**	**2007**
Poland	----	----	1,444,810	1,750,860	1,637,280
Spain	971,390	740,500	626,960	577,210	551,360
Italy	2,099,000	1,687,040	1,508,880	1,271,660	1,230,700
Germany	218,580	117,630	97,460	88,010	83,570

Table 3. Source Eurostat

Example of European countries agriculture holdings ≥ 50 ha					
	1990	**2000**	**2003**	**2005**	**2007**
Poland	----	----	17,880	20,700	23,640
Spain	86,980	99,900	99,950	99,670	101,190
Italy	38,370	36,540	40,400	38,620	40,010
Germany	56,280	78,670	83,540	84,600	85,360

Table 4. Source Eurostat

These tables were obtained trough data from Eurostat and we can prove that small farms are decreasing while the number of farms of more than 50 ha is increasing. For sure is not a huge increase in the number because each of this is like ten times the smaller.

Other data from Eurostat shows that also farms below 50 ha are decreasing their number.

There is one big reason for these changes. People don´t want to work in this sector. As a result of this behaviour some of them sell their fields to large enterprises or cooperatives. This enterprises can manage in a better way all the business concerning to the product obtained in their fields. They are more powerful than a group of different farmers because they can sell their product easily and very often they have more inputs so they can invest hardly than normal farmers in their fields. If they have a problem they can solve it easier than small farmers but also there are some disadvantages of this way of agriculture.

In summary, this is the first step to turn country´s agriculture in a serious business managed by enterprises or cooperatives that sometimes also give more employment than private small agriculture holdings.

1.3 Agricultural labour

In 2000, 25% of the employment in Poland was directly related with the agricultural sector. There are statistical problems about the definition of farmer in Poland. It is necessary to clarify that a person who works in agrarian sector is the person who is old enough to work and is working 40 hours or more per week in their holdings. According to this definition we can analyze some data at our disposal.

Age of agricultural holders in Poland			
	2003	**2005**	**2007**
Agri. holders ≥ 65 years	320,000	421,950	387,900
Agri. holders ≤ 35 years	353,430	313,350	293,750

Table 5. Source Eurostat

There is a common trend in almost all developed countries. This trend is that young people want to move to main cities in their countries. They want to obtain a job out of the agrarian sector. This is quite normal because is easier to obtain benefits in other jobs. However we can see the difference between agricultural holders of 65 years and young agricultural holders. Old people still have their fields and many of them work in their holdings even if they are retired.

It is not going to be a surprise if we can see in the future this amount of old people working in their fields decreasing seriously. It is going to be the consequence of the change of way of life of current young people.

There is a perfect example of this situation in Spain. In this country, agricultural sector is still so important but there is not young people who work in their fields so this kind of work are always covered by immigrants which offer to work in exchange of less money. Nowadays there is a big crisis in Spain and even if it is like that, few people want to work in this sector. Only if you have a good holding maybe you are going to obtain the same benefits that you can have in other works.

Agricultural employment in Poland (2000)	
Employers	70,000
Own account workers	1,804,000

Contributing family workers	654,000
Paid employees	130,000
Total	2,658,000

Table 5. Source GUS 2001c

How is the work divided in agriculture holdings? A 67.9% of the workers are working by themselves. They are not using extra aid from other employees and we can see this data are consequence of the high number of small farms that still remaining in Poland. Besides we also can see in table 5 that contributing family workers are also so important in this sector with 654,000 employees, nearly 25% of the total. Otherwise, it is significant low the amount of people who work like an employee in farms. Only 130,000 people, that´s less than 5% of all workers in this sector.

It is important to analyze this issue. If you try to turn agriculture of your country like an industry to make it profitable it is going to be important to have large holdings with many employees because family farms are only competent if you have a huge family and big amount of money to make the initial invest. However we also have to think that some people who have this farms, they are farmers because is the direct way to have food and only some of them can obtain benefits of their extra production (if they have). I really think this is a big problem because we are not talking about people who have other job and they can obtain extra incomes because of other job. If you want to turn to intensive this agriculture we have to think how we can proceed in this issue.

This topic is so hard and maybe is going to be fixed along next decades, while young people from small farms can obtain work not related with this sector. After this step, if they decide to sell this fields maybe it is going to be possible to create an enterprise or cooperative with them. I really think agriculture should change in this way in some farms in Poland. Anyway, these kind of farms are disappearing slowly, or maybe not disappearing but joining between them in cooperatives. By this way it is easier to be profitable.

Main source of rural income in Poland		
	1996 LFS (%)	***1999 Agricultural census (%)***
Work in agriculture	20.9	31.2
Work in non-agriculture	26.7	21.9
Pension (retirement, disability...)	27.5	30.8
Unemployment benefit	1.3	3.3
Other non-earned	23.6	12.8

Table 6. Source MARD 2000

This is so important data because we can analyze how people in the countryside obtain their incomes.

As we can see there is a big increase of incomes directly from working in agriculture. This is possible because there is a trend of change from small farms to larger farms and in these farms it is easier to obtain benefits because you are going to reach other amounts of production that allow you to have treatments to sell your product. This is one of the most important issues in agriculture. You have to ensure your production and also you have to search a good way of selling.

Because of the same reason we also can see that there are less people working outside of their farms at the same time. If you have a large holding it is so obvious that you are not going to have enough time to work in anyplace. This is full time agricultural holders.

There is also one way of income that is so important and between these years it grew from 27.5% to 30.8%. These are pensions. Many old people are receiving pension through their full life working in their fields, anyway, in some years is possible this amount is going to decrease a little bit because of the immigration of the youth people from countryside to main cities.

In the end, if Poland continues in the same way of development, there will be the same problem than in other countries like Spain. Young people are not going to want to work in countryside. If agricultural sector change his structure and start to create cooperatives or enterprises focusing in agricultural holdings is possible to create all kind of jobs: qualified jobs, non qualified, etc...

1.4 Types of farms according of their production (output)

At the end of 90´s, at least 12% of the polish farms were producing output only to survive (GUS, 1997b). This is a big amount of farms focusing only in survival agriculture. In this issue there are statistical contradictions again. The good point of the last data is that at least 85% of polish agriculture holdings are generating some marketable output.

On the other hand, there is another research about this issue conducted by HuneK, who says that 69% of polish farms produce only 5% of total agricultural output as “nominal”, producing primarily for their own needs (Hunek, 2000, p.39). This last research has sensitive differences with the first data because if it is like that, we should add to the amount of survival farms, at least one million holdings more.

This data is a so large problem. This percentage is now decreasing seriously because of the changes carried out because of EU accession. However, these farms should be more productive if agriculture in Poland is going to be more and more developed.

Hunek also says that most of these farms are from people who is retired or people who also have another way of incomes, so they really don´t need incomes from their work in their fields. There is another point of view about these farms that are creating work for people that maybe don´t have more alternatives and because of their work in these farms, they are avoiding social exclusion from their local communities. All these aspects are very important if we want to

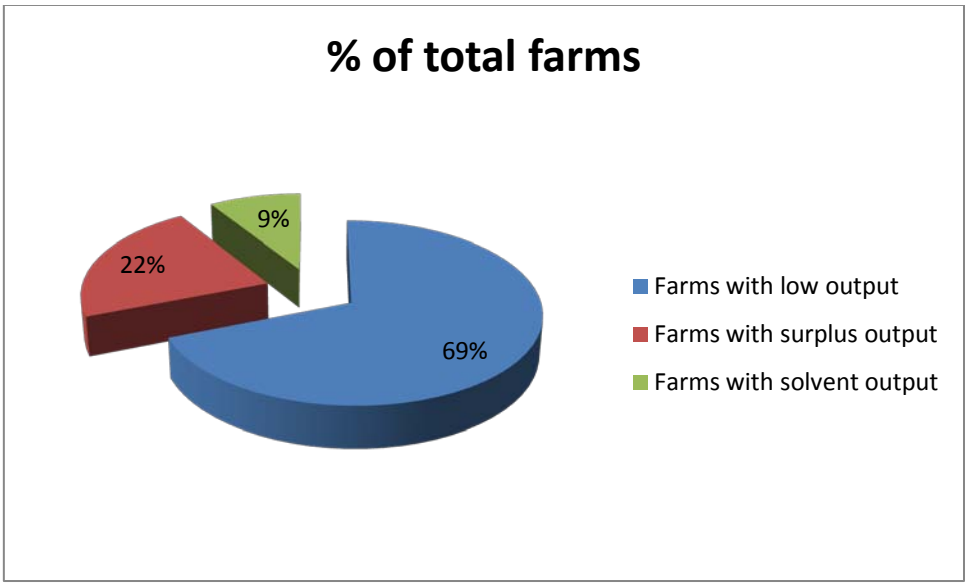
improve level of outputs because of one reason: if you we are the owner of one of these farms and we are not interest in its output, why are we going to invest in our fields?

There is another kind of farms according to Hunek. These agriculture holdings are those that are producing output for their own consumption, but surpluses are sold on local markets.

Some statistical researches account these farms as 22.4% of the total farms but another research could account it as nearly 30%.

In these agriculture holdings the level of output is higher and most of these farms have a good future in front of them. Almost all of them can improve trough not so expensive investments and they can have good place in European market. However is also important that some of these farms provide food directly to local farms to ensure local products, and if it is possible cheaper than products from outside.

The last group of farms according to Hunek scheme is large farms with large output. These farms are less than 9% of the total but they cover over 40% of agricultural land and produce almost three quarters of the value of total output. This is real agribusiness. In this way of farming, owners are innovative, creative and they take some risks. They are part of the most developed agriculture. Otherwise these farms must diversify if they want to be competent in foreign market. We are talking about new technologies and also new ways of work as for example integrated systems and also their own systems of processing and distribution. Another data of Census says that nearly 50% of the holdings can obtain marketable output, with more than 90% of associated holdings having 15 ha or more of agriculture land. According to the last data, 50% of polish farms have possibilities to be competent in European market.



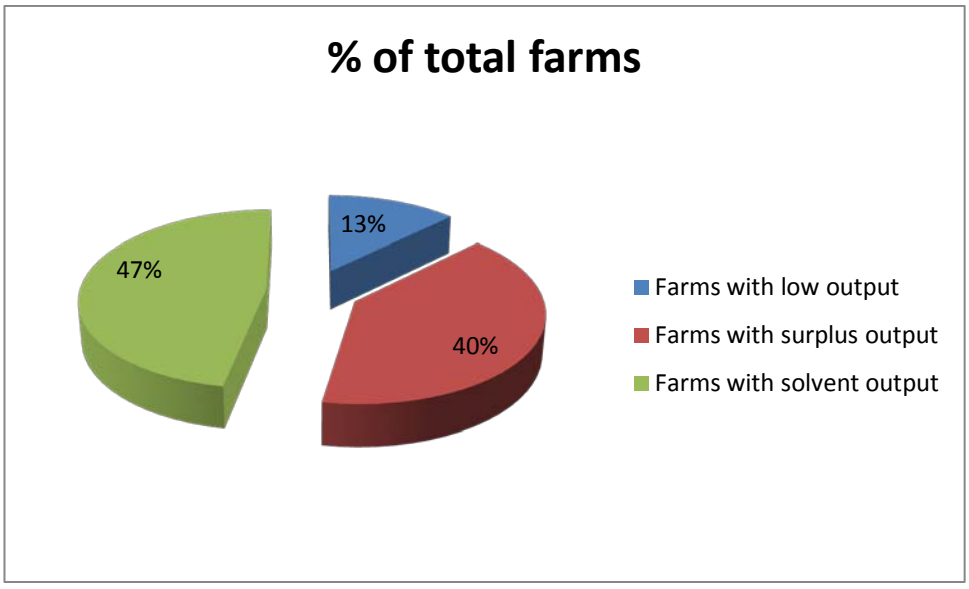
Graphic 1. Source Humek research

According to Humek´s research (graphic 1)this was the situation of polish agriculture holdings at the beginning of 2000. These data are not so good because according with the graphic only 31% of the farms can obtain marketable output and inside of this 31% we have to clarify that 22% is from holdings that obtain output for their own consumption and little extra production can be sold in local markets. As Humek defends in his research, there is only 9% of modern farms in Poland and 22% can be suitable to turn on it.

However there are more optimistic data about polish farms obtained from other researches. In graphic 2 we can see the obvious difference.

From my point of view polish farms are closer to be like in the second graphic with nearly 85% of farms with some kind of surplus output to sell in local markets.

There is one problem with small survival farms. Humek says that is not necessary to touch these farms because along the time these should improve or disappear. Maybe is not going to be as easier as he thought. We also have to pay attention in other problem directly related with young people from these farms. Some of them are going to try to obtain job in main cities but nowadays this question is so difficult because there already are so much unemployed people in the main cities so there is one big possibility that they can return to this way of life if they are not successful (Ingham, How big is problem in polish agriculture?, p.7). If the way of this nowadays crisis can change maybe there would be a possibility of a faster change in these holdings.



Graphic 2. Source: Census and MARD (2000,p.14)

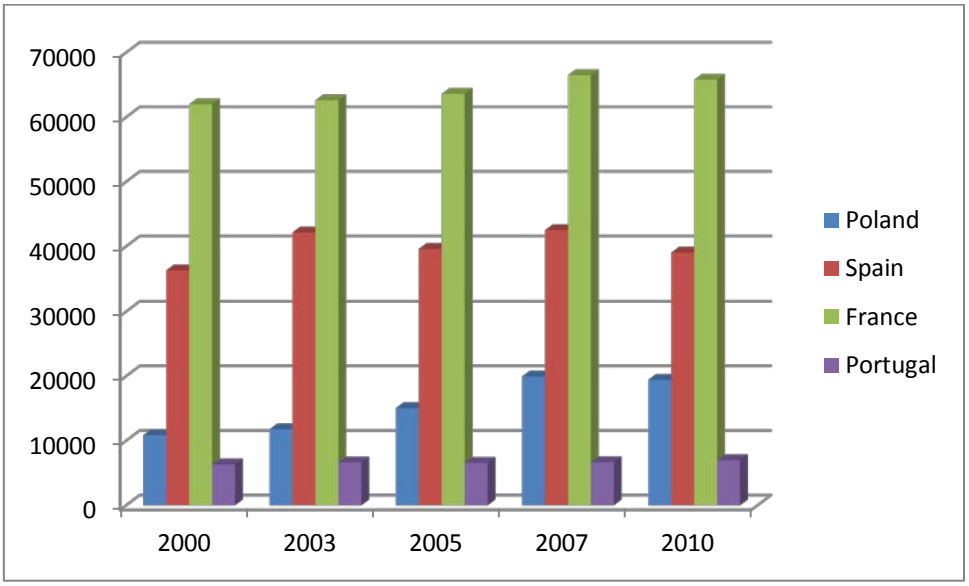
If we talk about total output of agriculture in Poland we are going to see an increasing trend from 2000 until 2010. Other countries like Spain or France are stabilised and they don´t suffer big fluctuations of their production but if we pay attention in Poland we can see and we can assure that agricultural output in this country is growing and it is so possible that Poland is

going to achieve high levels according to agricultural output. Is one of the less countries in Europe growing so quick. Only Romania can be compared with Poland at the same level of growing. As we can see, in 2000 production was 10,861.76 million of euro and in 2010 we can see they obtained nearly twice the value of 2000 with 19,437.2 million of euro.

At the beginning of last decade (2000-2010) there was a problem with low productivity in polish agriculture holdings but is so easy to see that these problems are being solved during these years (graphic 3).

The aim of graphic 3 is not to compare total output between countries because there are many differences between them and one of the most important is the location of the country. Poland can be so powerful if they continue by the same way, correcting all the mistakes in their agriculture and investing on it.

Low productivity problem could be fixed in a few years



Graphic 3.Total output from agriculture industry per country (Data from Eurostat)

1.5 Natural soil

Soil conditions are worse than in other members of EU and that´s because of the influence of glaciations periods during the formation of the soil. The result is that most of the surface of the country is composed by light soils on sandy, permeable ground.

The problem with the nature of the soil is not simple because there are few possibilities to cultivate some crops than in other countries.

Actual comparisons are better than previous ones because quality of the soil changed softly, but is still no good. Basing on the particle size and the capacity of retention there are researches which demonstrate that quality of polish soil is 25% less than other members of EU (National strategic plan, Ministry of agriculture and rural developing, p.25).

As ministry of agriculture of Poland assure, there are lot of problems because of erosion and also there is a lack of organic matter due to a decrease of 54.4% in arable land. Also acidification is a big problem with 54% of arable land particularly acidic.

1.6 Water resources

Poland is considered a country with low water resources. Watercourses in the surface are changing their volume every year and also water is not well distributed along the country. Central part of the country is affected by a water deficit while the mountain regions in the south very often are hit by strong rainfalls.

The best indicator of the problematic of Poland with water is the quantity of water available per person and year. This indicator is 1,300 m^3 / habitant / year and the average in Europe is 4,500 m^3 /habitant/ year (CSO, 2005).

It should be interesting to prepare some projects of water reservoirs because nowadays the amount of water that Poland keeps from rainfalls and thaw periods is only 6% of annual discharge.

1.7 Environmental problems

Environmental problems are always interesting for agriculture. Despite of this problem is not only related with agricultural activities, is an issue so important worldwide, and it is always interesting because we are using natural resources to obtain our product.

1.7.1 Problem 1: water pollution

During the second part of the XX century in Poland started to use more quantity of fertilizers with no strict criteria. So much quantity of nitrogen and also phosphorus were employed with a low rate of effectiveness. The percentages were 30% in case of phosphorus and 20% in case of nitrogen (Andrzej Sapek, The impact of agriculture on ground and surface water quality in Poland). Problems of this nature are always present in agriculture but not because is a common problem we have to pay less attention.

Is not fair if we say that agriculture in Poland was like that in all the country. Fertilizers were used in this wrong way or (too much) intensive way in places where agriculture was so

intensive and important for their economy. These regions were Poznan, Leszno, Kalisz, Konin, Wloclawek, Bydgoszcz and Torun. This information is so important because we are going to make our own research about polish farms close to Torun.

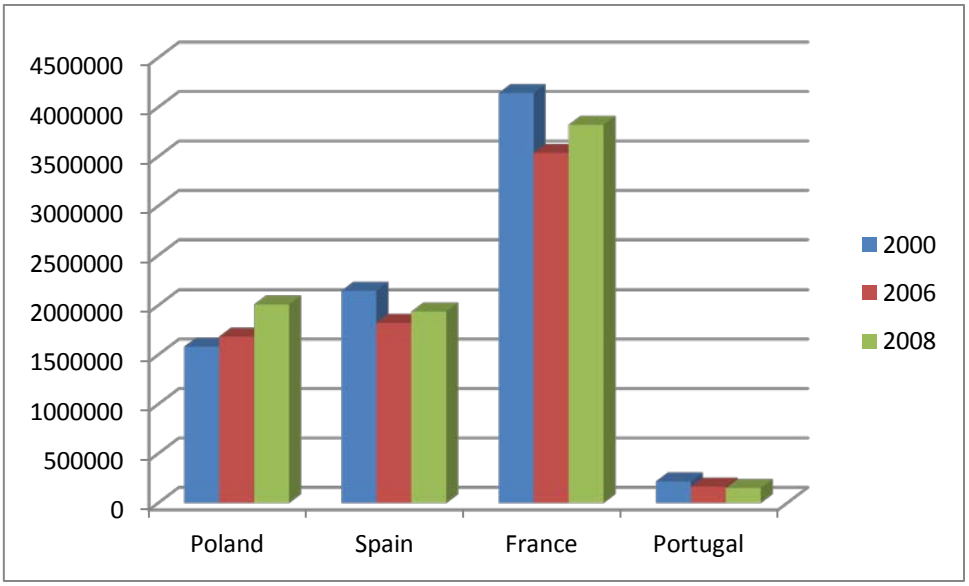
Designated region was compared with other six countries of Europe, some of them with the same length like the polish region. Results were similar if we compare with the other countries referred to nitrogen but levels of phosphorus were higher. About 50% of the soils in this region have a high level or very high level of contamination with phosphorus. Because of this fact, using fertilizers with high rate of phosphorus the quality of the water in this region is in serious risk as Sapek says.

Because of fertilizers and other products employed in agriculture is so important to be careful and to pay more attention, above all in this country where rainfalls in all aspects (rain, snow, ice) are so frequent.

It is known that when you add some substances to the floor, in this case, crop fields, many times this substance can be cleaned by water and it can pass so quick from the surface of the plant to the ground. This topic is a general problem in every country where agriculture is strong and because of it, it is important to regulate the use of these substances and search another ways to make them more efficient. For example, all agriculture holders should know that it is not good idea to treat your plants if there is a big probability off rainfall.

Once these substances are in the ground, many biochemical changes can happen turning these chemical components into other components more risky for underground water. Because of rainfalls many of these substances are going to be cleaned by the water and it is so probable that they are going to finish their way into aquifers and other kind of underground watercourses.

The same problem exists if there is a river close to crop fields. It should be interesting to check the quality of this watercourse to prevent more pollution.



Graphic 4.Million tonnes of fertilizers employed. Data obtained from Eurostat.

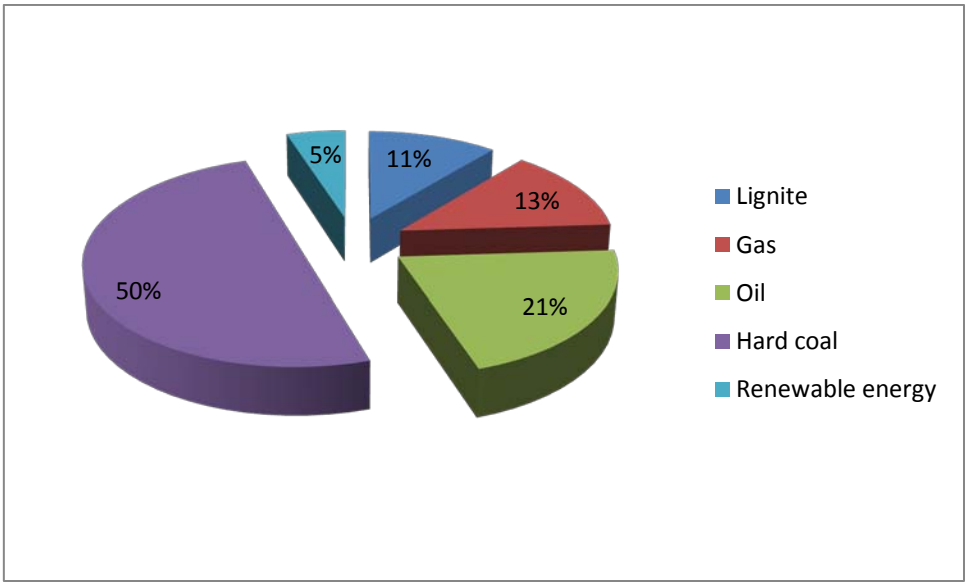
Fertilizer´s use doesn´t depend only of agriculture holder estimation. Chemical characteristics of the floor and also the structure and the capacity of nutrient´s retention are factors so important when holders have to add substances. That´s because is not fair to make a direct comparison between different countries like in graphic 4.

However is so interesting to review that Poland is one of the few countries that was increasing the use of fertilizers during last decade. This trendy contrasts with the amount of fertilizers that use the other countries, which is decreasing every year. It is possible to think that the main problem is low efficiency of some fertilizers. Because of this low efficiency, is natural that holders have to add more quantity of these substances.

Summarizing, water resources are so vulnerable against fertilizers and as it is described in water resources part, water is a scarce, so plans for developing fertilizers more efficient for polish fields may be one important priority.

1.7.2 Problem 2: Sources of energy and renewable energy

This issue is one of the most important inside environmental topics. Is not only related with agriculture but also in agricultural sector we can find high levels of fuel and other fossil sources of energy consumed.



Graphic 5. % of energy use in 2005. Source, Renewable energy policy review, p.2

According to graphic 5 we can see that there is a huge lack of renewable energies. In some countries like USA we can find that some agriculture holders are producing by themselves a little percentage of their energetic consumption. That´s because they are investing in these kind of energetic sources and it is a good business because if they can work a lap of time with their own produced energy, they are going to decrease their costs and also maybe they are going to obtain benefits if they decide to follow a policy of ecologic farming.

After accession to EU, Poland accorded to decrease the use of coal (main source of energy) consequently decreasing the level of harmful gas emissions to ozone layer. Many programs are developing and it looks renewable energies are becoming a site, at last, in Poland.

The region where is being done this research, Kujawsko-Pomorskie is the most developed region in Poland referring to clean energy production.

a) *Wind power*

Kujawsko – Pomorski Voivodeship is a great place to install windmills. There are some researches which show that there is a large potential to continue developing this source of energy.

Wind conditions in this voivodeship are so similar to Germany conditions and are not so far from Denmark and Holland conditions. For this reason, since 2002, between 11 and 20 new wind power plants and according to last data obtained, nowadays there should be more than 96 of them.

This is a good step, but is not still enough. In Navarra, one of the most developed regions in this sector in Spain, there are at least 1,200 windmills producing 950 MW. In fact, this amount of energy is a theoretical value because the problem of this energy is that it only works when wind can move the windmills blades.

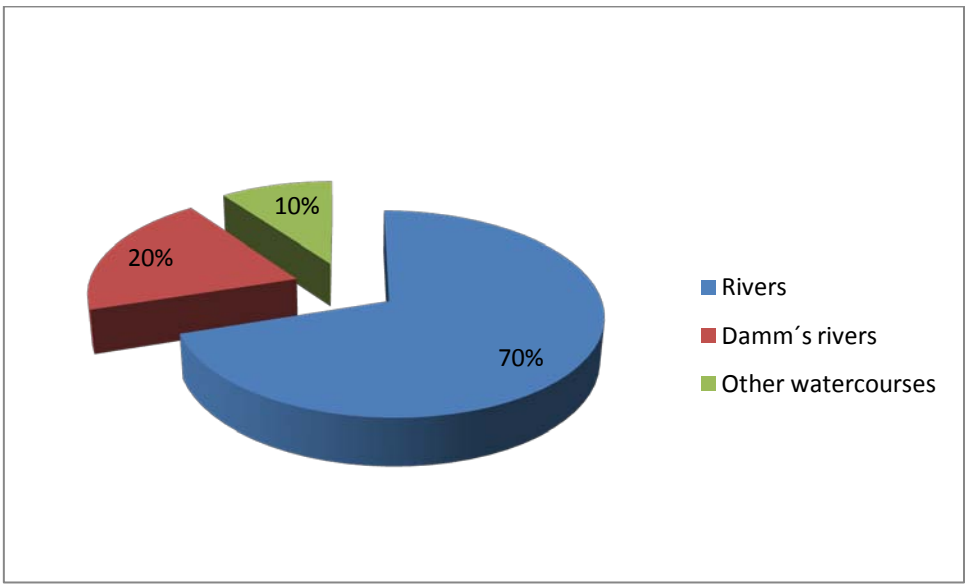
The closest aim in this region is to reach 2,540 MW of theoretical energy. It is a good amount of energy. However, people who tried to install wind power plants, they found many problems to obtain permission and also they had technical problems like how to connect these power plants to power network without problems of overloading.

b) *Hydropower*

Hydropower is one of the most important sources of energy in Poland between other renewable sources of water.

In this voivodeship there are currently 103 power plants working, located in the northern and eastern part of the region, depending where are the most favorable watercourse. Most of these power plants are small objects which can retain water in an easy way.

The majority of hydro power plants are installed on rivers and river dams and other watercourses. This percentage can be seen in graphic 6.



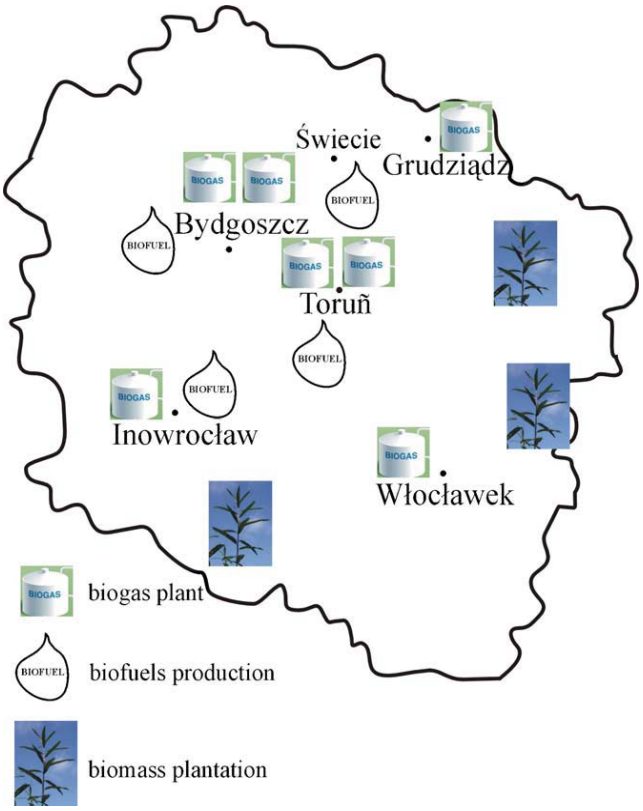
Graphic 6. Location of hydropower plants in Kujawsko-Pomorskie. Source.Renewable energy in the Kujawsko-Pomorskie voivodeship. P.2

There are many plans of new investments in this region about this kind of energy. Until 2015 there is a plan of 528 new plants and it looks there are going to be more. The only problem of hydropower energy is that it is a little bit more expensive than wind power, so people who invest should have more money or asking more in credits. This is a big difference between hydropower energy and wind power energy. Nearly 90% of people who have invested in wind power are going to continue investing in more plants. In the case of hydropower plants only 60% are going to continue.

c) *Biomass*

In this voivodeship there are many places where power plants of this condition are cultivated. There are many kinds of crops which we can use to obtain energy. For example, in 2007, in this region, areas of individual energy crops were: spring and winter rapeseed (2,419 ha), corn (51.4 ha), winter triticale (31.8 ha), oats (14.7 ha), energy willow (7.4 ha), sugar beet (2.1 ha).

There are 7 biogas plants, 4 biofuel producing plants, 3 big plantations of energy willow and numerous biomass boilers. This distribution can be appreciate in graphic 7.



Graphic 7. Distribution of biomass power plants in this region. Source, Renewable energy in the kujawsko-Pomorskie voivodeship, p.4

However there is a problem with this source of energy.

A continuous discussion about this topic is taking place these days because some scientists can see dangerous this way of obtain energy. The main reason is that we are using the same crops for eating than for making fuel.

Who is going to pay more for the production of this rapeseed field? If energetic enterprises can pay more for this production we are in a very high risk because many agriculture holders

would be able to change the destiny of their production to energetic issues instead of alimentation.

There are big problems in this topic in Brazil where the biggest rainforest of the world is placed.

In this country they are having many problems as a result of people who want to have fields to create biomass. Some of them are felling big areas of trees to obtain plane fields where they can have a good production to sell to energetic power plants.

So, this energetic plan should be careful, because if we don´t pay attention in how to obtain energy from crops, maybe we can be more harmful for environment. We have to develop this business taking care about carbon cycle. Anyway, there are many researches which support this way of production, but always under control.

Benefits of a responsible biomass power plants according to ucsusa.org:

a) We also can use crops which don´t compete with food crops.
b) We can use portions of crops residues such as wheat, straw or corn stover.
c) We can use sustainable harvest of wood and forestry residues.
d) We can clean municipal and industrial wastes.

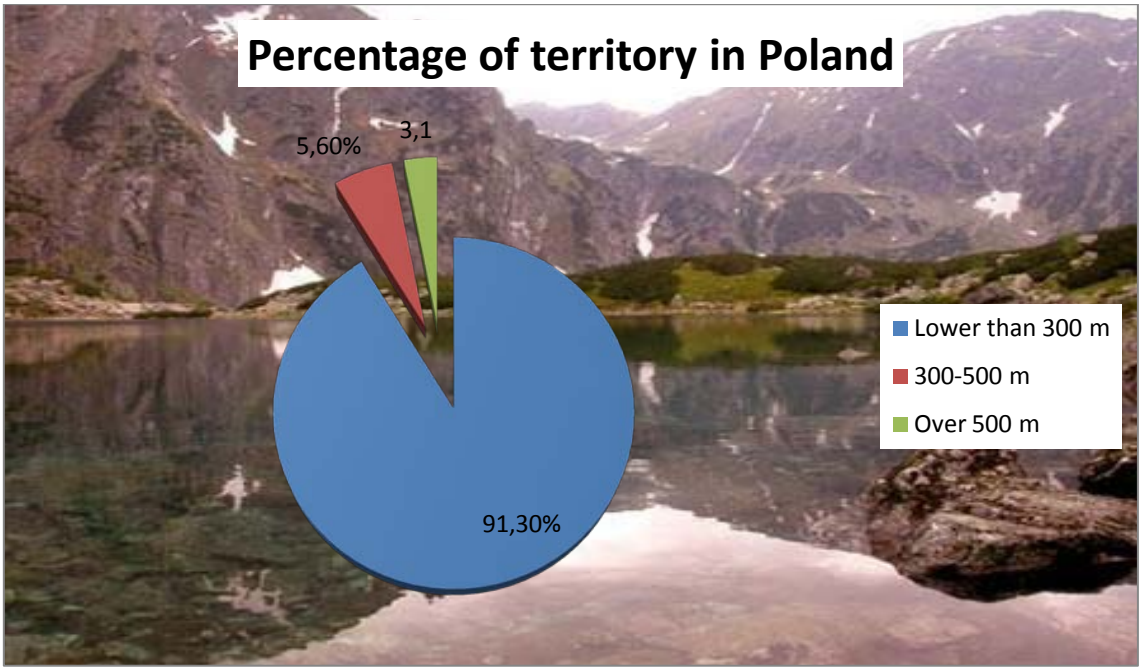
From my point of view these are the current main problems of polish agriculture. Some of them are not exactly problems because of human fault and also there are some of them that are completely in process to fix it.

Now it is going to be some data and explanations about Poland, the country where my research has taken place.

2 General information about Poland

The Republic of Poland is one of the largest countries in Europe with 312,685 km^2. It is the 69^{th} largest country in the world. Concerning to official estimation it is the 34^{th} country according to population. Its number was 38,192,000 at the end of 2010.

Poland is a lowland country if we talk about orography. The average of territory height is about 173 m. Territory lower than 300 m constitutes about 91.3%. If we are talking about uplands the percentage is 5.6% and concerning to mountains (over 500 m) is only 3.1%. We can see it better in graphic 8.



Graphic 8. % of territory in Poland. Source, www.poland.pl. Picture: Tatra mountains

As we can see in graphic 8, most of the territory is lower than 300 m. We can think that because of this reason Poland is a good country for agriculture and is not false. There are many plane crop fields which is positive to work in a good way without technical problems. However, if we talk about other problems related with agriculture like pests and illness is not so interesting. Very often, we need natural barriers to stop them, like mountains. Because of the lack of mountains between crop fields, forests turn more important for agriculture as a natural barrier. Other kind of natural barrier is to diversify the kind of crops in a specific region to avoid the transference of the illness or the pest from one field to the next one.

Even if the most part of the landscape in Poland is lower than 300 m, this country hasn´t a monotonous landscape. We can find a lot of forests and more than 9,300 lakes. Besides, there are many rivers. The two important rivers are Wisla and Odra.

1) Wisla river is the longest: 1,047 km.
2) The biggest lake: Sniardwy (Mazury Lake district), 11,383ha.
3) The deepest lake is: Hancza, 108 m.
4) The highest mountain is: Rysy (Tatra mountains) 2,499 m.

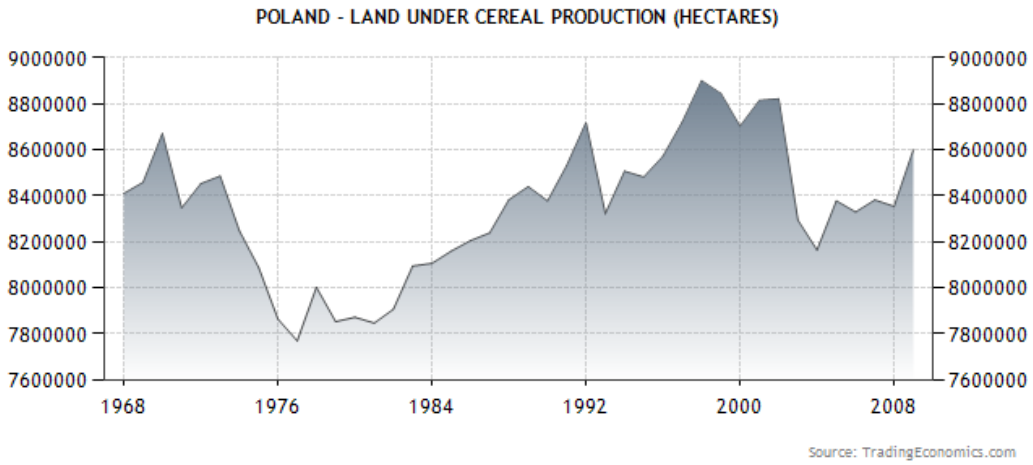
2.1 Main crops in Poland

In this part of the research there is going to be a description of the main crops in Poland and also there will be a comparison between production in Poland and production of the same crop in other countries from European Union.

2.1.1 Production of cereal

Land under cereal production was rising during last 30 years. This data is good because it means that Poland doesn´t have to import cereal production from other countries. This data ensures that it is possible to find products which come from cereals, cheaper than if Poland had to buy to another country. Increase of the land aimed to cereals cultivation can be checked in graphic number 9 where we can see the trend.

Winter cereal and spring cereal are typical here as we will be able to see in the surveys of material and methods.

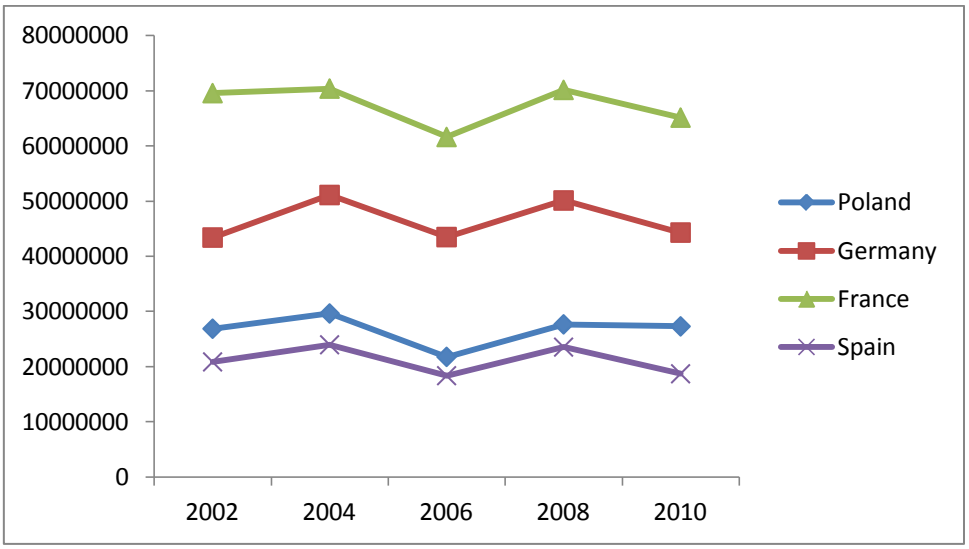


Graphic 9. Source: Tradingeconomics.com

As we can see in graphic 9, there were bad times for cereal production during 70´s and right now, is again recovering from the last production drop. Nevertheless, it is important to pay attention in the comparison made in graphic 10 and table 7 where we can observe that Poland is an important producer of cereal inside of Europe.

Cereal production in Europe (Tn)					
	2002	**2004**	**2005**	**2006**	**2008**
Poland	26,877,300	29,635,100	21,775,900	27,664,300	27,299,300
Germany	43,391,300	51,097,000	43,474,800	50,104,900	44,293,000
France	69,555,700	70,381,500	61,613,200	70,142,000	65,121,600
Spain	20,863,800	23,965,500	18,367,500	23,544,000	18,715,300

Table 7. Source: Eurostat



Graphic 10. Production of cereal in Europe (Tn). Source: Eurostat.

Data showed in graphic 10 are so important for Poland. Nowadays Poland is the third largest producer of cereal in Europe and only Germany and France are over it. Production depends not only of investments but also of meteorology. We can realize that the reason of the soft fluctuations of productions may be due to weather.

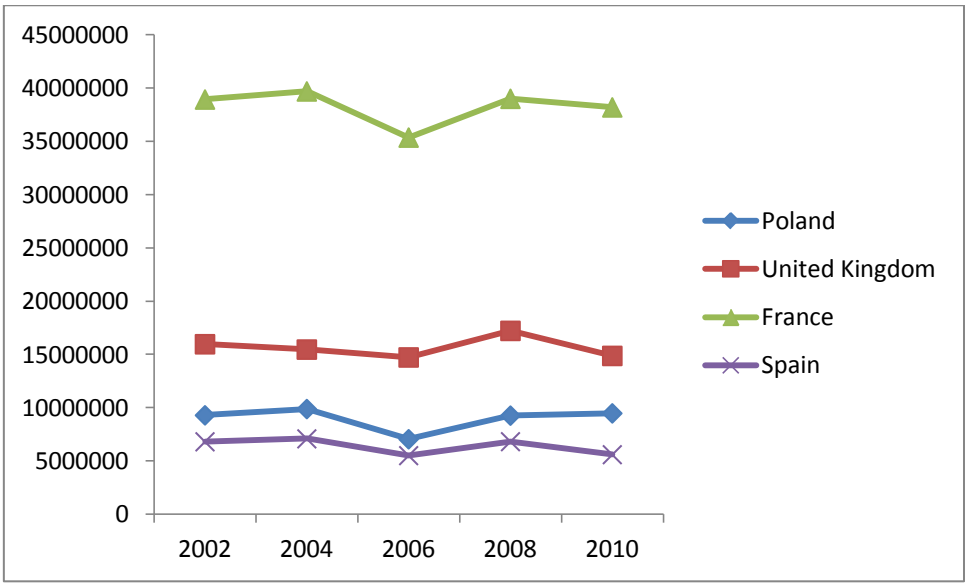
2.1.2 Production of wheat

Wheat is one of the main cereals in Poland and its production is high. Is enough high to compare with the best producers in Europe. As we can see in the table 8 and graphic 11, wheat is about 30% of total production of cereal in Poland but for example, in France, we can observe that wheat is at least more than 50% of total cereal´s total production.

Wheat production in Europe (Tn)					
	2002	**2004**	**2006**	**2008**	**2010**
Poland	9,304,000	9,892,500	7,059,700	9,274,900	9,487,800
U.K	15,973,000	15,473,000	14,734,600	17,227,100	14,878,000

France	38,933,400	39,692,900	35,363,600	39,001,700	38,194,700
Spain	6,822,200	7,096,700	5,521,600	6,831,500	5,610,700

Table 8. Source: Eurostat



Graphic 11. Production of wheat in Europe. Source: Eurostat.

Cereal production and focusing in wheat is so important not only for market but also for the own agriculture holders. Most of the farms we visited in this region were farms with mixed production, animal and crops. Because of this structure, many times, part of the crop production goes directly to feed their animals. In small farms this production used to be enough but in medium and large farms, owners have to buy extra food for their animals.

This could be one of the main reasons of why in Poland cereals are so important. For mixed holdings, is helpful to obtain their own food to feed their animals and later buy them. In other countries like in Spain, we can find also this kind of holdings but not very often like in Poland. In Spain we can find that most of the times people don´t have mixed holdings, at least not at the same way like here. They have very often fields where animals can eat but also they have to buy food. In Spain is more common to see holdings focusing in crop production than in animal production, but also it depends of the region.

In summary, it is believed that if the holding is focusing in only one aim, maybe the quality is going to be better and your product can be more valuable. For example, ecology farming; there are some holdings in Spain that want to sell good quality of product, in their cases, milk. Animals should be fed in a normal way, and they have to be more freedom than in other kind of holdings. For this reason they have fields where animals can be feeding themselves and fields to obtain food also in ecological way. This kind of holdings where the owner wants to search different product (very often more expensive and more quality) appears because a lot

of consumers are asking for this kind of products. The question is if in Poland this kind of products has a good exit in market because if it is not like that, producers prefer not to spend more money to obtain it, it is obvious. Supply and demand.

2.1.3 Production of rape

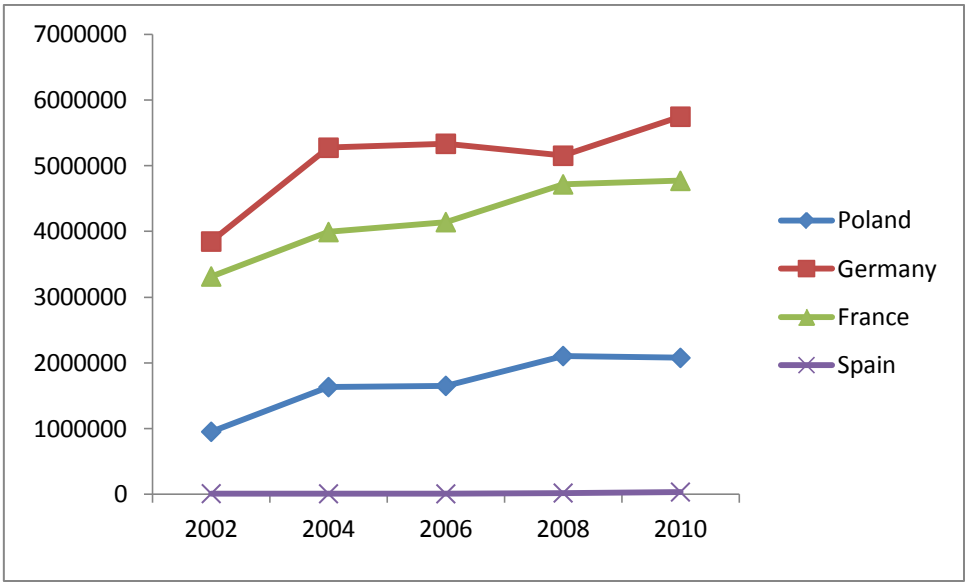
Rape is a characteristic crop in the north of Europe. Production of rape is directly related with production of rapeseed oil. As we can check in table 9 and graphic 12, the importance of this crop is higher in north of Europe and the main reason is because in Mediterranean countries like Spain and Italy, people use olive oil and sunflower oil for cooking.

Is the third kind of oil most used on the world. This kind of oil is cheaper than others and also has good nutritional properties. It is used in an industrial way for heavy machinery as a lubricant.

It has nearly 50% of erucic acid which can be harmful for health, specially related with cardiovascular problems. Nowadays and after long period of researches and genetic crosses there are more types of this oil with less quantity of erucic acid. For example, 0.02% of erucic acid. However, in some countries like Poland and France was selling oil with nearly 40%, which is dangerous for the hearth.

Production of rape in Europe (Tn)					
	2002	**2004**	**2006**	**2008**	**2010**
Poland	952,700	1,632,900	1,651,500	2,105,800	2,077,600
Germany	3,848,700	5,276,600	5,336,500	5,154,700	5,748,700
France	3,317,000	3,993,500	4,144,500	4,719,100	4,772,900
Spain	10,800	8,800	7,900	20,800	35,500

Table 9. Source: Eurostat



Graphic 12. Production of rape in Europe. Source: Eurostat

Germany and France are the biggest producer in Europe but Poland is the third one. This production is divided because of the aim of the production. Sometimes is destined for industry and sometimes for alimentation.

In countries like Spain this oil doesn´t have space in the market because of olive oil and also because there was a huge problem related with rapeseed oil in 80´s. It was a problem with rapeseed oil adulterated which caused more than 700 deaths and more than 20,000 affected. Besides this not good reputation, olive oil was gaining market´s ground to rapeseed oil and sunflower oil.

Spanish state had to pay more than 1,427,000,000 euro (and.es) to affected people and nowadays there are still people without receiving this money.

We really think that this problem begins in the moment that some producer wanted to buy this oil to industry and in the end, it was destined for alimentation. For sure is not the exact type of oil. Industrial rapeseed oil is adulterated with many components to improve its efficiency.

As we can check in table 9 rapeseed production is increasing during last years and that is because in some countries, producers are being stimulated to expand the surface of this crop. The main motive is biodiesel and food.

According to soyatech.com Poland is the seventh producer of this oil in the world (data from 2006). Worldwide production was 47 million of tons at 2006 and Poland produced nearly 1.6 million of tons (table 9).

Worldwide production of rapeseed oil (million of Tn)		
Country	***Production***	***% of total***
China	12.2	25.95
Canada	9.1	19.34
India	6	12.77
Germany	5.3	11.28
France	4.1	8.72
United Kingdom	1.9	4.04
Poland	1.6	3.4
Australia	0.5	1.1
Other countries	6.3	13.4
Total	47	100

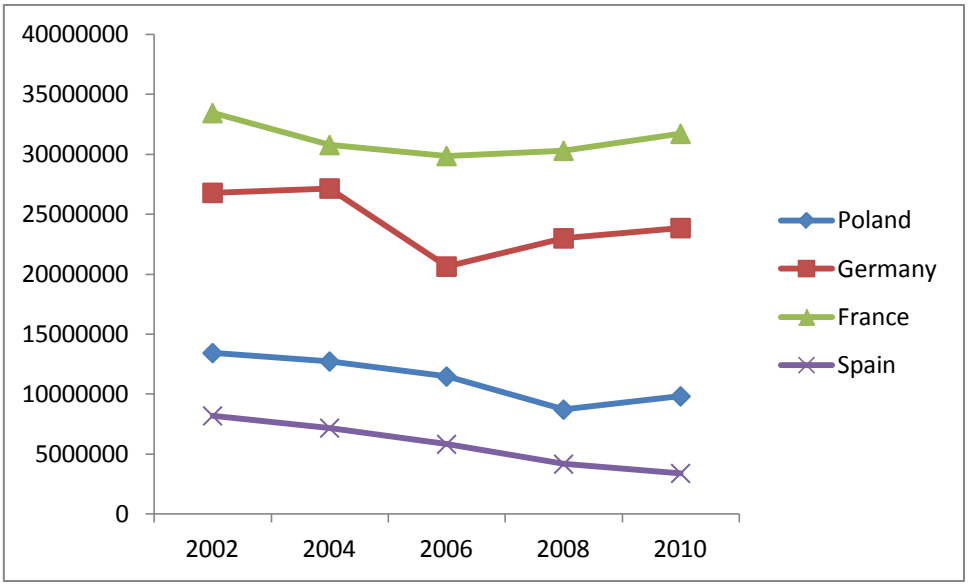
Table 9. Data from Soyatech.com

More than 4 million tones of this total production were directly used in biodiesel in 2006. Poland became in the 7th worldwide producer with only 3.4% of total production. Nowadays, production in Poland is higher and it is estimated nearly 2.1 million tons which mean that production increased in 2010 more than 20% from Poland´s production in 2006. It is a huge growth.

2.1.4 Production of sugar beet

Production of sugar beet in Europe (Tn)					
	2002	**2004**	**2006**	**2008**	**2010**
Poland	13,433,900	12,730,400	11,474,800	8,715,100	9,822,900
Germany	26,794,300	27,159,000	20,646,600	23,002,600	23,858,400
France	33,449,900	30,788,300	29,871,400	30,306,300	31,723,000
Spain	8,197,300	7,174,900	5,827,000	4,170,700	3,399,400

Table 10. Source: Eurostat



Graphic 13. Production of sugar beet in Europe. Source: Eurostat

As we can see in graphic 13, Poland is a good producer of sugar beet. However, it is in Europe where we can find a large production of this crop. Because of the production is focused in this continent, Poland turned into the 8th worldwide producer in 2005 (table 11), according to FAO.

Worldwide production of sugar beet (million of Tn)		
Country	***Production***	***% of total***
France	29	11.98
Germany	25	10.33
U.S.A	25	10.33
Russia	22	9.1
Ukraine	16	6.61
Turkey	14	5.78
Italy	12	4.96
Poland	11	4.55
United kingdom	8	3.3
Spain	7	2.89
Other countries	73	30.17
Total	242	100

Table 11. Source: FAO

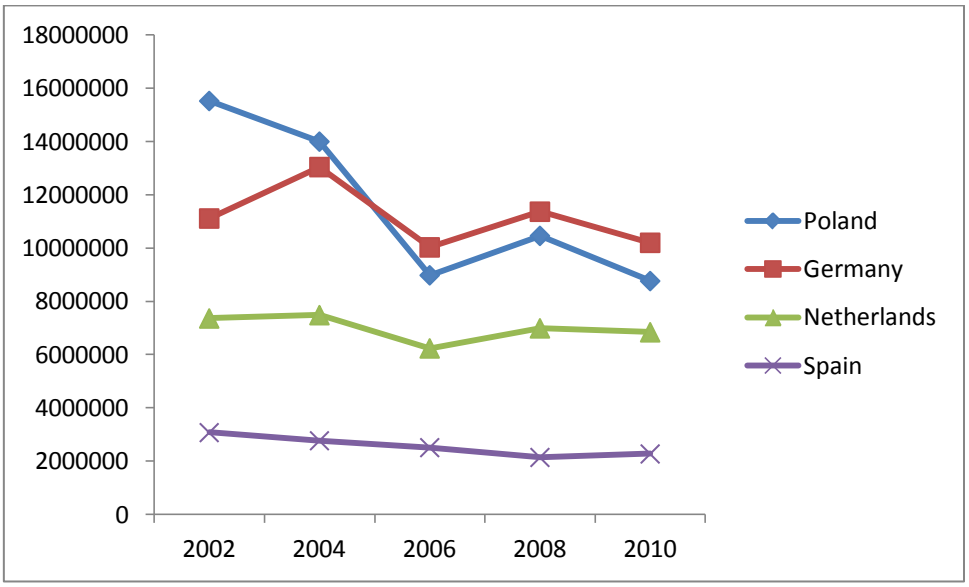
2.1.5 Production of potato

This crop is the most important in Poland. This country was until 2005 by far the largest producer of potatoes in Europe. We can find that in Poland this high production is divided in many farms in small scale. Potato´s crops cover the 10% of the total agriculture in Poland.

There are 112 registered varieties of which 77% are table potatoes.

Production of potato in Europe (Tn)					
	2002	**2004**	**2006**	**2008**	**2010**
Poland	15,523,900	13,998,700	8,982,000	10,462,100	8,766,000
Germany	11,113,900	13,043,600	10,030,600	11,369,000	10,201,900
Netherlands	7,362,700	7,487,700	6,239,600	6,992,700	6,844,900
Spain	3,078,100	2,773,600	2,515,000	2,146,900	2,277,900

Table 12. Source: Eurostat



Graphic 14. Potato´s production in Europe. Source: Eurostat

Data from 2002 show that cultivated area in 2002 was 800,000 ha, of which 540,000 were in small farms with nearly 1.4 million of farmers. In total, small holdings produced 9.5 million tons, which was 61.2% of total production.

In addition, about 200,000 ha were cultivated by specialized potato farmers. Theses farmers were specialized in table potatoes (100,000 holdings), seed potatoes (6,500 holdings), starch potatoes (20,000 farmers) and potatoes for processing (400 farmers).

Table potato´s farms, seed potato´s farms and starch potato´s farms, have an average length of 1-2 ha while farms where potatoes for processing are cultivated have about 50 ha.

The three first kinds of farms are scale farms and in these cases we can find that application of manure was so high in 2002, while in large farms (potatoes for processing) it was only occasionally.

Almost all the specialized farms have a good system of irrigation while in small holdings they have to manage annual rainfalls. (Ref: Potato production in Europe, Soren Marcus Pedersen, Jan Bizik, Luisa Dalla Costa, João Coutinho, Frantisek Dolezal and Anna Gluska).

As we can see in graphic 14, production in Europe is decreasing last years. The main reason is that production is moving from developed countries to developing countries (some countries in Asia and South America) as we can see in table 13.

Top worldwide potato producers (Tn)	
Country	**Quantity**
China	72,040,000
Russia	36,784,000
India	26,280,000
United States	20,373,267
Ukraine	19,102,300
Poland	11,791,072
Germany	11,643,769
Belarus	8,743,976
Netherlands	7,200,000
France	6,271,000

Table 13. Source: FAOSTAT

Some countries of Asia are interested in this crop because they consume high quantity of potatoes so they started to produce it. In table 13 we can check China and India between the three first producers.

According to FAOSTAT, we can compare efficiency of production in different continents and we can observe that in Europe we can obtain 17.4 tons/ha, while Asia obtains 15.7 tons/ha. This is normal rates of efficiency but it should be good for holdings in Poland and in the rest of the world to copy producing systems of potato in North America where they obtain 41.2 tons/ha.

2.1.6 Production of carrot

Poland is one of the leading carrot producers in the European Union. Bartczak (2009) reports that in Poland carrot production is growing 33 thousands of hectares and the total yield was 935 thousand tons in 2009.
Although production is high, it could be higher because the efficiency of polish fields is not so good as we can see in table in table 14.

Production of carrots in Europe			
Country	**Area harvested**	**Production (Tn)**	**Yield (Tn/ha)**
Poland	33,000	935,000	28.33
United Kingdom	9,883	677,144	68.52
France	14,980	667,948	44.59
Italy	13,454	602,441	44.78
Netherlands	8,800	543,000	61.70
Germany	9,858	516,000	52.14

Table 14. Source: FAOSTAT 2009

Efficiency of carrot´s polish producers is a big problem as we can see. Generally, yield is not lower than 44 tons per hectare but in Poland yield is 28.33.
In many farms in Poland this trend is changing because holders are investing in machinery and new ways of working on the fields.

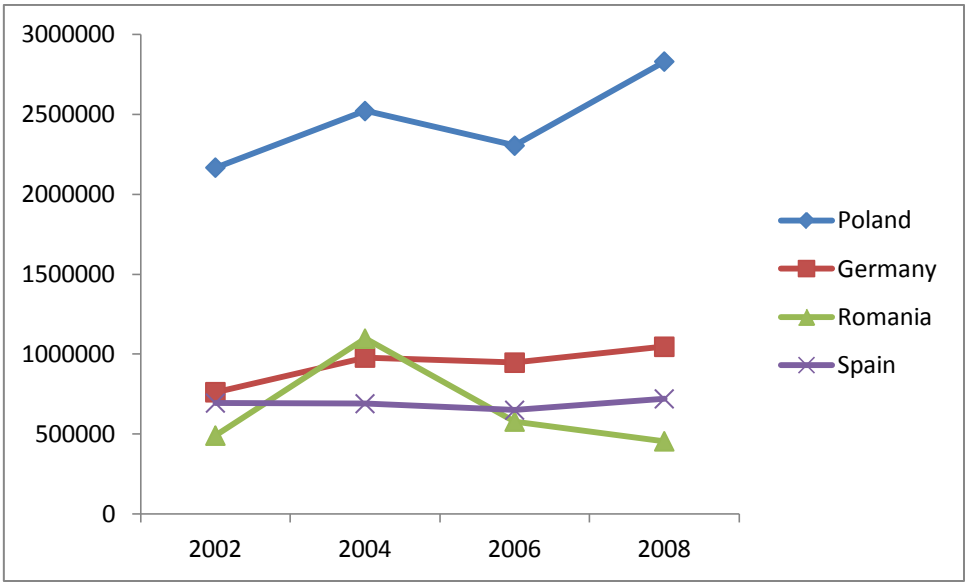
For example, it would be so profitable for production if we have a harvester which can be rent to other holders. In Spain, this system is so common. Some holders can offer to rent their machinery in one area where they know this kind of machinery is necessary (harvest time) and agriculture holders rent it knowing that they can cultivate more intensive because they know they can harvest it faster than only with human force. In this case, both of them are achieving their aim because for the owner of the harvester it is an extra income and for the holder is cheaper to rent the machinery instead of buying it.

Also is so important if we decide to use a little amount of water by irrigation. It doesn´t mean that we have to irrigate our fields every day. As we can see in other researches (Production-related and economic conditions of edible carrot cultivation in Poland, Beata Szwejkowska, Tomasz Winnicki, Pavelas Duchovskis), irrigation should be during the growing season, only once during the carrots plants are emerging.

Production of carrot in Europe during last decade (Tn)					
	2002	**2004**	**2006**	**2008**	**2010**
Poland	692,100	927,900	833,200	817,000	814,900
Italy	561,400	607,200	619,700	594,900	No data
France	727,600	672,600	625,300	556,600	No data
Spain	436,800	445,400	489,200	No data	424,300

Table 15. Source: Eurostat

Anyway, in table 15 and graphic 15 we can see that production, even if the polish yield is not so good, is very high.



Graphic 15. Production of carrot in Europe. Source: Eurostat

In the end, like in another kind of crops, it is necessary to obtain high yields and most of the times high yields are following several investments which sometimes are not possible but other times it is only necessary to change holders mind and make see them that it is going to be an obligation to invest and take little risks if Poland wants to be a serious leader in this crop production.

2.1.7 Fruit production:

Production of apple

Apple production is the most important fruit production in Poland and also one of the largest in Europe.

Apples represent more than 80% of fruit production in Poland. Besides the national production sold in national market, there is also a huge market with other countries. International market is so interesting to apple producers because it is known that apple production in Poland is cheaper than apple production in Germany, so apples in general are cheaper in Poland than in other European countries. Because of this reason, Poland sold last year 1.5 tons of apple to other countries.

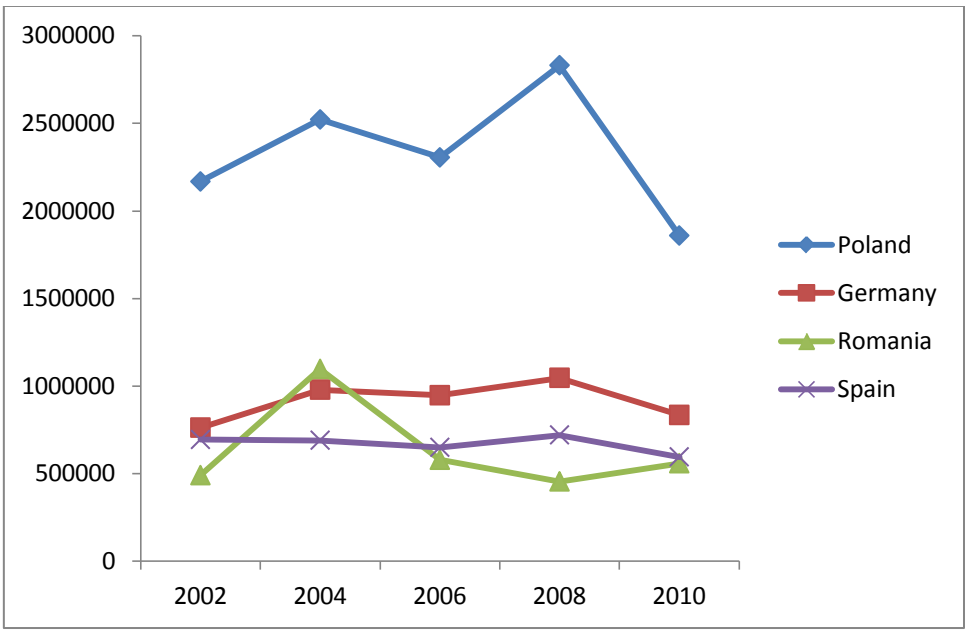
Countries like Algeria, Morocco, Tunisia and others are buying apple from Poland because is cheaper than other European countries. This is a good strategy (Polandapples.com).

It is important to pay attention in this data: Poland is the second apple juice concentrate producer in the world after China and before USA.

We can observe data of European countries production in table 16 and graphic 16.

Production of apple in Europe (Tn)					
	2002	**2004**	**2006**	**2008**	**2010**
Poland	2,167,500	2,521,500	2,304,900	2,830,900	1,859,000
Germany	762,800	979,700	947,600	1,047,000	835,000
Romania	491,500	1,097,800	579,400	455,900	559,600
Spain	694,800	690,900	650,400	721,200	596,000

Table 16. Source: Eurostat



Graphic 16. Production of Apple in Europe. Source: Eurostat

Difference between Poland and the other countries is huge. As we said before, part of this production is destined to apple juice.

From my point of view it is important to show that Poland is good in this field and create a kind of appellation of origin that shows everywhere the product is sold, that it is from Poland or at least from one region in Poland. For example, Citricos Valencianos (Valencian citrus, Spain). These kinds of organizations protect the product and allow create a good marketing network which is going to make polish apples more famous.

Nowadays, there is something similar and is known that new cooperatives are appearing so this process has just started and market with countries from Africa is already stabilised but Poland should make its product more competitive in other countries

Appellation of origin also means to keep a really good level of production and to increase investments and use a more sustainable agriculture.

There are many examples about these groups of producers behind an appellation of origin and it is demonstrated that level of incomes of agriculture holdings are higher, agricultural companies appear which offer more quantity of jobs, so region can turned into an interesting place to search job. Region would suffer a good development. Anyway, it is important to know that this kind of "fruit brands" only can appear if there is a good quality of the production in this region. Many times, this amount of quality is only possible investing in new technologies and also taking risks.

2.1.8 Under glass area

This point is a little bit difficult in Poland. Agriculture could be better if there were more crops under glass, but weather in Poland makes this topic difficult. During last years total area under glass has been decreasing seriously in Poland as we can see in table and graphic number 17. Anyway, it is still one of the countries with more ha under glass.

Under glass area in Europe (ha)					
	2002	**2004**	**2006**	**2008**	**2010**
Poland	8100	8600	8200	6300	6300
Netherlands	10500	10500	10400	10200	9200
Romania	1200	700	2500	3100	3300
Portugal	2100	2100	2100	2200	2200

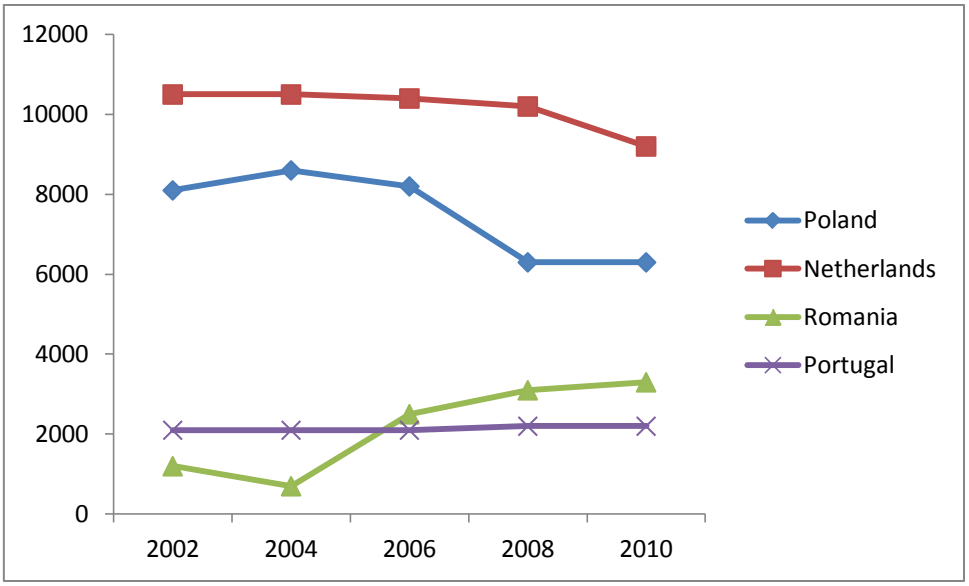
Table 17. Source: Eurostat

At the beginning, greenhouses were built to cultivate tomatoes, cucumbers and lettuce but this way of production became expensive because of energy costs, so many vegetable producers had to turned their under glass holdings in floriculture and ornamental holdings.

Production of flower in Poland suffer an increase of 400% if we compare rates from nowadays with 1970´s rates.

Nearly 70% of flower production takes place in private greenhouses with an average area of 500- 2000 m^2.

There are 1,800 ha of heated greenhouses under glass and there are also nearly 2,000 ha under plastic greenhouses, most of them without heating and some of them only heated in spring and early autumn (Floriculture and ornamental plants in Poland, R.M. Rudnicki.



Graphic 17. Production under glass (ha). Source: Eurostat.

3 Scientific approach and methods

The real aim of this research is to check how Polish agriculture is, so after the previous explanation we are going to analyze data obtained directly from agriculture holders while this research was being done.

These data were obtained through a complete template designed for this aim. Data were of different nature like, kind of crops, animals, fuel, machinery, and other aspects like how is the labor in each farm.

With these data we are going to analyze how agriculture holdings are in this region. For this reason we are going to use one method developed by V.Tellarini and F.Caporali.

3.1 Model of a farming system

Tellarini and Caporali designed one graphic model about how energy and matter flow through the farm. This kind of model is important because it allows us to control inputs and outputs. We also can control where energy is from and where is going to be in the next step.

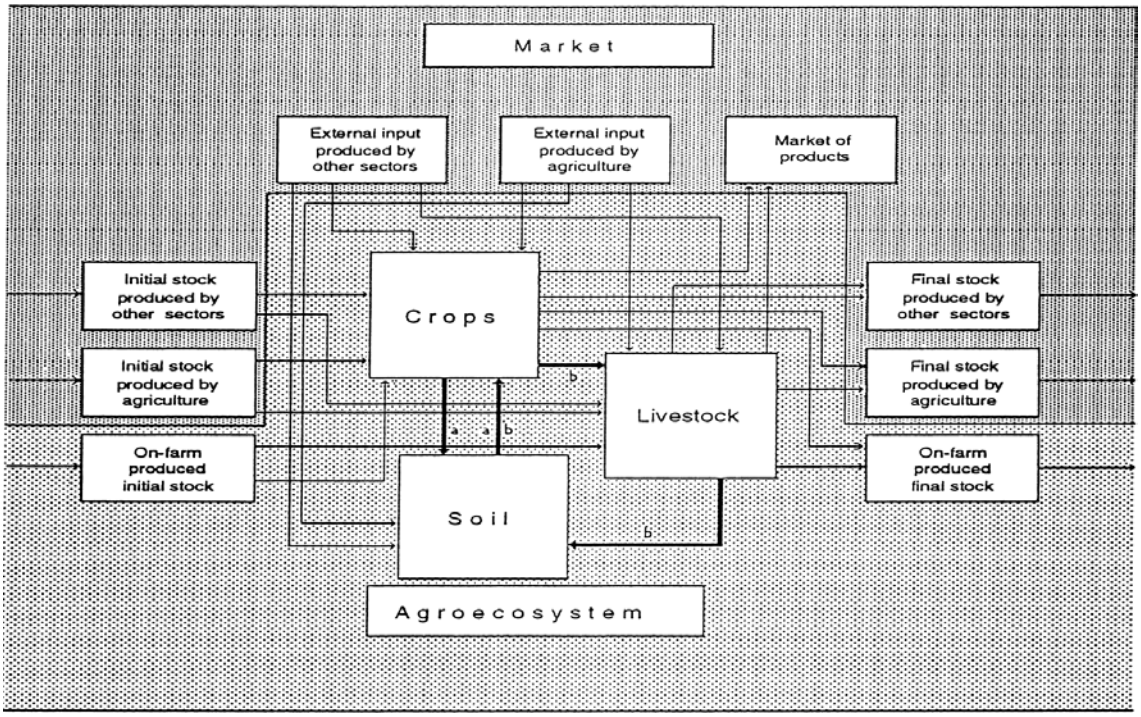


Figure 1.Spatial- temporal representation of an agroecosystem. V. Tellarini, F. Caporali

Thanks to this design, it is possible to follow energy flow since the moment that agriculture holder refill his machinery with fuel until the moment he obtain all his production. As an example.

As we can see they divide circulation in the figure 1:

- Small circulation (a)
- Large circulation (b)

This circulation is going to take place between the three main aspects of a mixed farm which are:

- Crops
- Animals
- Soil

Small circulation (a) is going to be, circulation of matter and energy between crops and soil. Large circulation is matter and energy flow between crops, animals and soil.

This model is perfect for our research because even if the study is only focused in crop´s area of a farm, here in Poland, most of the farms are mixed, which means that there are crop production and animal production.

Each arrow links two boxes and that means that these two sectors of the farm are related. First sector would be the one which provides matter and energy and the second sector is going to receive matter and energy. The methodology can be applied to the farms which it´s considered to be organized like that: individual fields, individual crops, cultivation systems and animal´s breeding and whole farm.

With this method it is possible to check that every main field in the model, like crops, soil and animals are an aggregate of elementary units which from a basic Input/Output matrix, can be seen to make up a large number of items, varying from one sector to another.

For each item, the material, energy and monetary flow can be analyzed both to and from other sectors and to and from the outside world.

Each sector is similarly linked to the others, for example:

- *Small circulation*: Crops and soils exchange water, gas, mineral elements and organic compounds.
- *Large circulation*: Crop sector supplies the livestock sector with biomasses for re-use, and the livestock sector, in turn, supplies manure back to the soil sector.

Between these three sectors we can observe that they involved all matter and energy flow in the model.

Small and large circulation, activated by solar energy, constitutes the motor of the entire production process according to Draghetti (1948). This motor is also feed by inputs from outside and can produce outputs which can be re-used in the farm or also they can leave the system definitively.

The market where it is supposed that the farm is immersed has been divided in two big parts:

- Primary sector, like agriculture.
- Other sectors.

There is another aspect of this model in which we have to pay attention and it is the time. Inputs can come from another cycles which were before and also outputs that we obtain in new cycles can be re-used in next cycles. This movement between cycles is going to be important at the time to analyze if the farm is sustainable.

3.2 Methods and protocol

In this research we are going to study 19 farms from Kujawsko-Pomorskie region. To reach the main aim of it we are going to obtain data from these farms through a complete template. We are going to obtain data of many aspects of the farms but we are going to pay special attention in crops never forgetting that farms in this region are most of them mixed, so also it is going to be necessary to mention something about animal production and everything around the farm.

3.2.1 Data collection

Data were collected through a template where it is possible to analyze some interesting points of farms. Nicolas Copernicus University gave us some advices about how this template had to be and with their great help and information it was possible to obtain it.

Template has different parts:

General data: It is possible to know general data like size of the farm, how is the ownership, type of the farm (animal production, crop production or mixed production), data from holders (age, education, number of people living there...).

Soils: What kind of soils they have in their holding.

Plant production: Kind of winter and spring crops, costs of it, amount of material bought, chemical protection, fertilizers and other data like destination of the production.

Animal production: Kind of animals, costs of it, amount of animals and data of production.

Machinery: Machinery employed with some data of fuel and weight.

Energy: Material used to obtain energy and data of electric energy.

Labour: Time dedicated to work separating different tasks inside of the farm.

There is an example of this template in annex 1.

3.2.2 Data processing

All data collected were united in excel sheets differentiated in the following points.

Whole farm: General data of different inputs like crops, fungicides, etc...

Seed material: Data of seeds employed.

Fertilizers: Inputs of fertilizers separated in different chemical components.

Crop protection chemicals: Inputs of fungicides, herbicides and insecticides.

Crops: Output data of crops differentiating seeds and straw.

Oils and fuels: Inputs of oils.

Human work: Data of labour.

Electricity and others: Data of machinery, electricity, and other fossil sources of energy.

In all these points, there are conversion calculations related with all these data collected. The aim of this research is to find how are matter and energy´s flows in holdings so we needed conversion factors for every data. These indicators of conversion are attached in tables in the following pages.

By this way it is so easy to calculate total amount of matter that enters in the farm and also how much matter goes out and also we can know in which way. Conversion factors provide us of a general vision of energy flow which is going to be very important to obtain conclusions.

3.3 Method of energy flows

To study energy flows it is necessary to support one publication which is very helpful: “A method of energy balancing in crop production and its application in a long-term fertilizer trial” written by K.J Hülsbergen, B. Feil, S. Biermann, G.W. Rathke, W.D. Kalk and W. Diepenbrock (Agriculture, ecosystems and environment 86 (2001) 303-321.

It is possible to find very different pictures of the energy use in agriculture. It is because it´s necessary to pay attention in some different points of energy in agro-ecosystems.

- The thermodynamic analysis: Represents the highest level and includes all energy flows as well as the entropy and order of systems.
- The ecosystem analysis: The inclusion of solar energy brings with it a problem of scale. If solar energy is included, then, the use of support energy in agricultural systems becomes a very insignificant component of the total energy flow, whereas this is often the component of greatest interest in the system.
- The process analysis is a more mechanistic technique, attempting to trace all the energy inputs into an agricultural system, based on physical material flows.

The method used in this study corresponds to the process analysis. Human labour and solar energy are not usually considered in the energy balance of agricultural production systems. Very different approaches for evaluating the energetic cost of human labour have been suggested. Fluck (1992) described nine methods, including the energy requirements of the muscles, food requirements during working hours, and the so-called “life-style support energy”, which considers all products and services used by the farmer and his family.

The energy equivalents associated with labour vary considerably, depending on the approach chosen; they must be adapted to the actual living conditions in the target region. Refsgaard et al. (1998) are of the opinion that human labour and fossil energy are too different to be expressed in the same units.

Depending on environmental conditions, crops convert only 0.5–5% of the photosynthetic active radiation (PAR) into biomass (Greef et al., 1993); the conversion rate shows large fluctuations during the day and from day to day (Dannowski et al., 1981).

The authors assumed an average field size of 20 ha and an average inner-farm transport distance of 2 km. The machinery used was typical of that used on commercial farms. The concern is only with the input of fossil energy, which consists of two components: fossil

energy consumed on the farm in the form of diesel fuel and electricity to power the engines (=direct energy) and fossil energy consumed beyond the farm for the manufacture of the production means (=indirect energy) (Table 1). Inputs of energy for drying, storage, and transport from the farm to the customers were not taken into account. The energy output was defined as the calorific value of the harvested biomass (main products and by-products).

3.4 Tables

Table 1

Definition of energetic parameters

Energetic parameter	Definition	Unit
Direct energy input (E_d)	Input of diesel[a]	GJ ha^{-1} per year
Indirect energy input (E_i)	Seed[b] + mineral and organic fertilizers[c] + pesticides + machines	GJ ha^{-1} per year
Energy input (E)	$E = E_d + E_i$	GJ ha^{-1} per year
Energy output (EO)[d]	Energy in the harvested biomass (main product + by-product) − energy in the seed	GJ ha^{-1} per year
Net energy output (NEO)	NEO = EO − E	GJ ha^{-1} per year
Energy intensity (EI)[e]	EI = E/GE	MJ per GE
Output/input ratio (OI)	OI = EO/E	–

[a] Based on site- and yield-dependent data, which were subjected to regression analyses.

[b] Energy input for processing, storage, and sale of seed.

[c] The energy input with farmyard manure was derived from the nutrient content (N, P, K) and effectiveness relative to that of mineral fertilizers (substitution value).

[d] Calorific value.

[e] Energy input per unit product; the various products are converted to grain equivalents (see Table 6).

Table 2

Average energy input associated with selected field operations[a]

Field operation	Energy input			
	Direct (diesel) (l ha^{-1})	Direct (diesel) (MJ ha^{-1})	Indirect (MJ ha^{-1})	Total (MJ ha^{-1})
Ploughing (25 cm depth), moldboard plough	25.2	998	143	1141
Stubble tillage, disc harrow	6.1	242	152	394
Spraying of pesticides	1.7	68	29	97
N fertilization	1.5	59	28	87
Spreading of farmyard manure	16.6	659	813	1472
Harvest of cereals (yield 5 t ha^{-1})	15.2	602	354	956
Harvest of sugar beets (yield 50 t ha^{-1})	27.0	1070	1074	2144

[a] Adapted to different conditions (working depth, rate of application, yield) by regression equations.

Seeds

Group of crops	Energy value in MJ/kg
Cereals	
Spring barley	15,90
Winter barley	15,90
Mixture of creals	16,20
Spring oat	16,60
Winter oat	16,75
Spring wheat	16,10
Winter wheat	16,10
Triticale	16,75
Winter rye	15,70
Root crops	
Sugar beet	16,90
White beet	16,90
Carrots	16,80
Potatoes	17,19
Legumes	
Bobik	16,70
Pea	16,90
Buckwheat	16,80
Bean	16,80
Lupin	18,80
Oil and fiber plants	
Colza	26,90
Mustard	16,80
Forage plants	
Red clover	16,80
Maize for animal feed	16,20
Vegetables	
beetroot	16,80
Others	
Grass	16,80

Table 3. Energy of seed material (Ziołecka i in., 1985).

Fertilizers

Type of fertilizer	Pure component	Type of fertilizer	Pure component
Urea - N	46 %	Magnesium sluphate - Mg	9,6 %

Polifoska		Calcium-magnesium nitrate	
- N	6 %	- N	30 %
- P	20 %	- CaO	4 %
- K	30 %	- MgPO	2 %
Lubofoska		Polimag 405	
- N	4 %		
- P	12 %	- N	5 %
- K	12 %	- P	10 %
- Mg	2 %	- K	20 %
- Ca	16,5 %	- Mg	6 %
Potassium salt		Amonium nitrato	
- K	60 %	- N	34 %
Saletrzak		Magnesium sulphate	
- N	28 %	- Mg	9,6 %
Magnesium amonium nitrate		Agrofoska	
- N	34 %	- N	23 %
- Mg	0,2 %	- P	32 %
Calcium magnesium		Superfosfat	
- Mg	18 %	- P	15 %
- Ca	30 %	- Mg	5 %
Calcium		Amonium sulphate	
- Ca	60 %	- N	18 %
Manure		Compost	
- N	0,5 %	- N	1,34 %
- P	0,13 %	- P	0,66 %
- K	0,58 %	- K	0,34 %

Table 4. Procentowa zawartość czystego składnika nawożeniowego (Dovring i McDowell, 1980) oraz polskich źródeł literaturowych.

Pesticides

Name	**Totally energy [MJ/kg]**
Herbicide	
- Oil mixture	418,2
- aqueous solution	262,8
- granules	362,5
Insecticide	
-Oil mixture	363,8
- aqueous solution	257,3
- granules	311,0
- powder	311,0

Fungicide	
-Oil mixture	271,7
- aqueous solution	116,2
- granules	216,0
- powder	216,0

Table 5.The energy contents of 1 Kg of plant protection products. (Pimentel, 1992)

Fuel

Energy source	**Total cost of energy**
Diesel and others oils	47,78 MJ/l
Coal	32,59 MJ/kg
Wood	18,90 MJ/kg

Table 6. The total cumulative cost of energy production oil and other energy (Cervinka, 1980).

Energy

Energy carrier	**Energy value**
1. Coal	20,93 MJ/kg
2. Culm	15,00 MJ/kg
3. Wood*	18,90 MJ/kg

Table 7. Energy value of selected energy (Skrobacki, 1982)

Labour

	number of hour per day	**number days per year**	**number of hour per year**
plant production			
work in taller			
animals			

Table 8. Parameters which we taken into consideration at assessing the work of people.

We use energetic conversion (Ryszkowski I karg, 1992 za Pimentel i Hall, 1984). The equivalence is as follows:

1 rbh = 2,4 MJ

Output

Group of crops	Energy value in Mj/Kg
Cereals	
Spring barley	
- Grain	15.90
- Straw	15.60
Winter barley	
- Grain	15.90
- Straw	16.10
Mixed cereals	
- Grain	16.20
- Straw	16.00
Spring oat	
- Grain	16.60
- Straw	15.90
Winter oat	
- Grain	16.75
- Straw	16.00
Spring wheat	
- Grain	16.10
- Straw	16.10
Winter wheat	
- Grain	16.10
- Straw	16.20
Triticale	
- Grain	16.75
- Straw	16.10
Winter rye	
- Grain	15.70
- Straw	16.00
Root crops	
Sugar beet	
- Roots	17.13
- List	12.21
White beets	
- Roots	16.45
- List	14.77
Potatoes	
- Tubers	17.19
- Leaves and stems	16.52
Legumes	
Bean	17.10
Pea	
- Grain	16.90
- Straw	16.40
Buckwheat	16.90
Bean	16.80
Lupin	
- Grain	18.80

- Straw	16.70
Oil and fiber plants	
Oilseed rape	
- Grain	26.90
- Straw	16.60
Mustard	
- Grain	16.80
- Straw	15.24
Forage plants	
Red clover	15.70
Maize for animal feed	
- Grain	16.40
- Straw	15.00
Vegetables	
Beetroot	16.22
Others	
Grass	16.80

Table 9.

All these tables allow us to obtain detailed information about the exact energetic value of each element which enters in action in farm´s activity.

3.5 Description of the area (Czernikowo)

- *Water:*

In this region is possible to find two zones of water catchment which are Vistula and Lubianka. Steklin lake is connected with Gnilszczyzna river which in the past was connected with Vistula river. This water course is the biggest in this area. Its bottom is covered by water plants, its deepest point is 18.5 m. It has two terraces: lower (4 meters from the water surface) and higher (10 meters from the water surface). Its coastline consists mainly in farmlands.

Wygodzkie lake is another lake of the region and is situated in the south part of Steklin lake and its depth is 4-5 meters.

In the northern part of the area we can find chain lakes like Liciszewskie lake, Mazowieckie lake, Piotrkowskie lake, Kijaszkowo lake. This last lake crosses Lubianka. 80% of farmlands and 20% of meadows and grasslands surround the lake, nearby are located fishing ponds (60 ha). The western bank is higher than eastern one.

- *Soil:*

In the past this area was covered by mixed forest where dominated oaks and beech and the very thick undergrowth. Brown soil is the main soil covered high parts and slopes. In the flat parts it causes great possibility to grow wheat.

- Southern parts of the area: soils not very good to cultivate.
- Northern parts: various ability to cultivate

Private area covers big part of the territory and protected soils (types I-IIIb) consist 30.6% of agricultural land.

- *Climate:*

It is a characteristic climate because it is a mixture between maritime and continental climate.

- Annual temperature (average): 7,5 °C.
- The highest temperature during the summer:39 °C
- The lowest temperature during the winter: -25 °C
- In autumn (September/October) and spring (beginning of June) temperature sometimes reaches values below 0°C.
- Annual precipitation sum: 510mm. The lowest values appear in February. The highest : July.
- Depth of snow (average): 7 cm

High oscillations between annual precipitation, e.g. 1951- 312mm; 1980- 843mm; Thus, some years can be catastrofic for agriculture because of drought and some because of too big precipitation

- *Production area:*

1. *Arable land*

In the figure 1 it is possible to see how farms are distributed different concerning to their length.

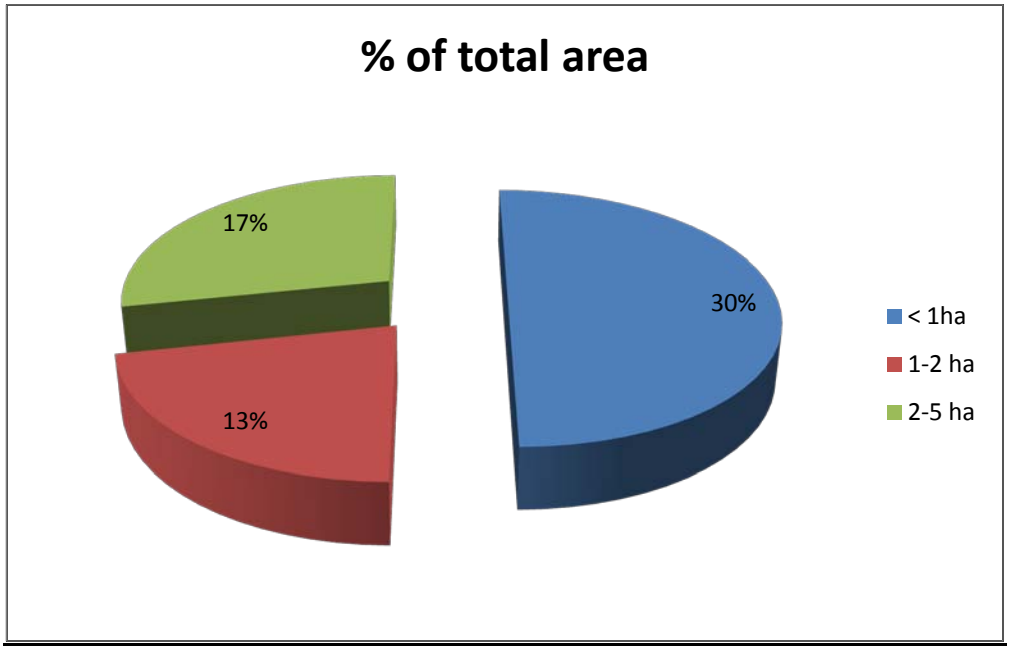


Figure 1. Percentage of farms in Cernikowo concerning to length.

Cultivation and farming

- Mixed crops: 128,672 ar (23%)
- Triticale: 72,340 ar (13%)
- Barley: 64,422 ar (12%)
- Wheat : 74,118 ar (13%)
- Rye: 59,251 ar (11%)

- 568 (16%) farms cultivate potatoes.
- 529 (15%) farms cultivate mixed crops.
- 384 (11%) farms cultivate tiricale.
- 344 (10%) farms cultivate rye.
- 329 (9%) farms cultivate barley.

- Hen (15,336 – 34%)
- Pigs (14,353 – 31%)
- Hen (9,427 – 20%)
- Cattle (3,496 – 8%)

- 50 % of farms produce for the market.
- 30% of farms produce mainly for their needs.
- 16% of farms/households don´t produce.
- 4% of farms produce only for their needs.

Natural resources:

Lack of natural resources. Only on the southeastern part of area we can find sand and gravel. Farmers import sand and gravel from the surrounding area of the community.

2. *Forestry*

Forests cover 45.1% of the area (7,873 ha) and 819.5 ha is private area.

- 2005 – forestation of 225.3 ha
- 2007 – forestation of 5.6 ha

The most common kind of tree is Pinus and there are also another kind of species like: Quercus robur, Alnus glutinosa, Betula pendula, Fraxinus excelsior, Ulmus, Tilia, Acer and Populus.

3. *Main towns and cities*

- Torun- northwestern side
- Lipno – southeastern side
- Golub Dobrzyn – norteastern side

4. *Connected wildlife*

There are three natural parks:

- Kijaszkowo- landscape park. 10,5 ha. Devastated. Established in XVIII-XIX. 39 species of trees and bushes (6 species of coniferous tree).
- Steklin- 8 ha. Devastated. Established in XIX. 52 species of trees and bushes (10 coniferous species).
- Steklinek- 8,7 ha. Devastated. Established in XIX. Private area. 30 species of trees and bushes (1 coniferous species), lots of grasslands.

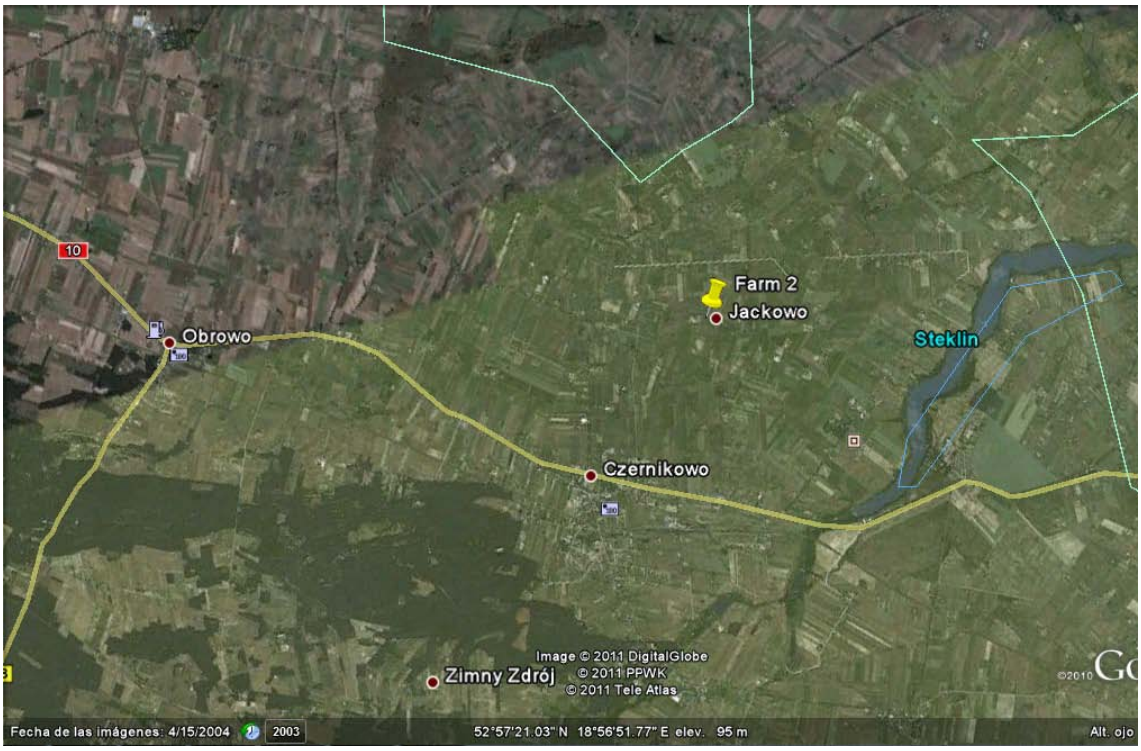
Protected area: Steklin Lake (112,9 ha) with its buffer zone, surrounding deciduous forest.

3.6 Farms information

Farm 2

Information group	Type of information
Farm 2	
General farm data	N 52º 57.320´ E 018º 58.871´
Type of prodcution	Their production is focus in animal and conventional.
Demographic strucute of the household	The owner is between 50-60 years old and he has trade school studies. There are 2 adults and 2 kids living in the farm.
	He has 1 person working temporary for 3 days.
Primary production	Arable land: 8ha Meadows: 8,34 ha Build-up area: 0,30 ha
Secondary production	Pigs: -3 sows -13 wild boar piglets -8 piglets Cows: -12 Milkcows -8 calves Horse:1 male
Input in primary production compartments	Crop protection: -herbicides: 0,26l/ha Sources of fertilizers: Urea, lubofoska, ammonium nitrate, manure.
Inputs in secondary production compartments	Concentrated: 1,5tn Grain: 4tn
Output primary production compartments	Winter crops: -triticale: 4,20ha→18,9Tn Spring crops: -Mixed: 3,80ha-→19Tn
Growth of herd	Milk production: 38000litres They sold: 30 pigs, 2 cows, 2 calves and 6 milk cows.
Family labour	Plant production: 1680 hrs/year Work in taller: 547,5 hrs/year

	Animals: 1460 hrs/year

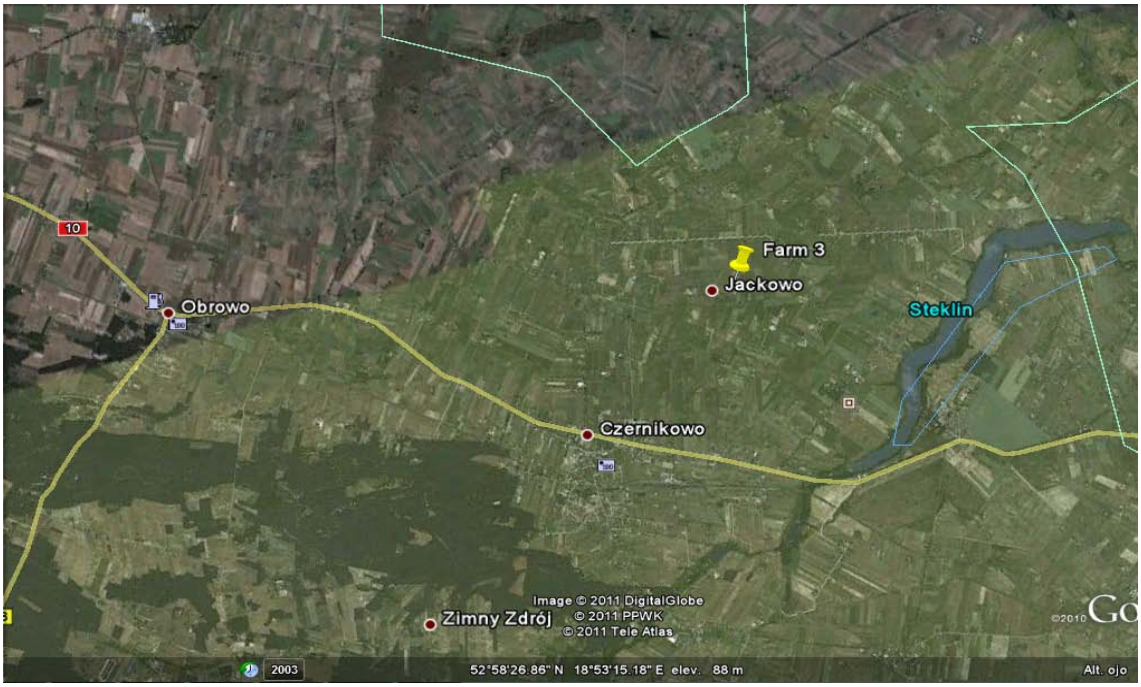


Farm 2. Source: Googel earth.

Farm 3

Information group	Type of information
Farm 3	
General farm data	N 52º 57.320´ E 018º 58.852´
Type of production	Their production is mixed and conventional.
Demographic structure of the household	The owner is between 50-60 years old and he has agronomical studies. There are 4 adults living in the farm..
	They have people working temporary
Primary production	Arable land: 86,3 ha Build-up area: 0,5 ha
Secondary production	130 pigs: -36 sows

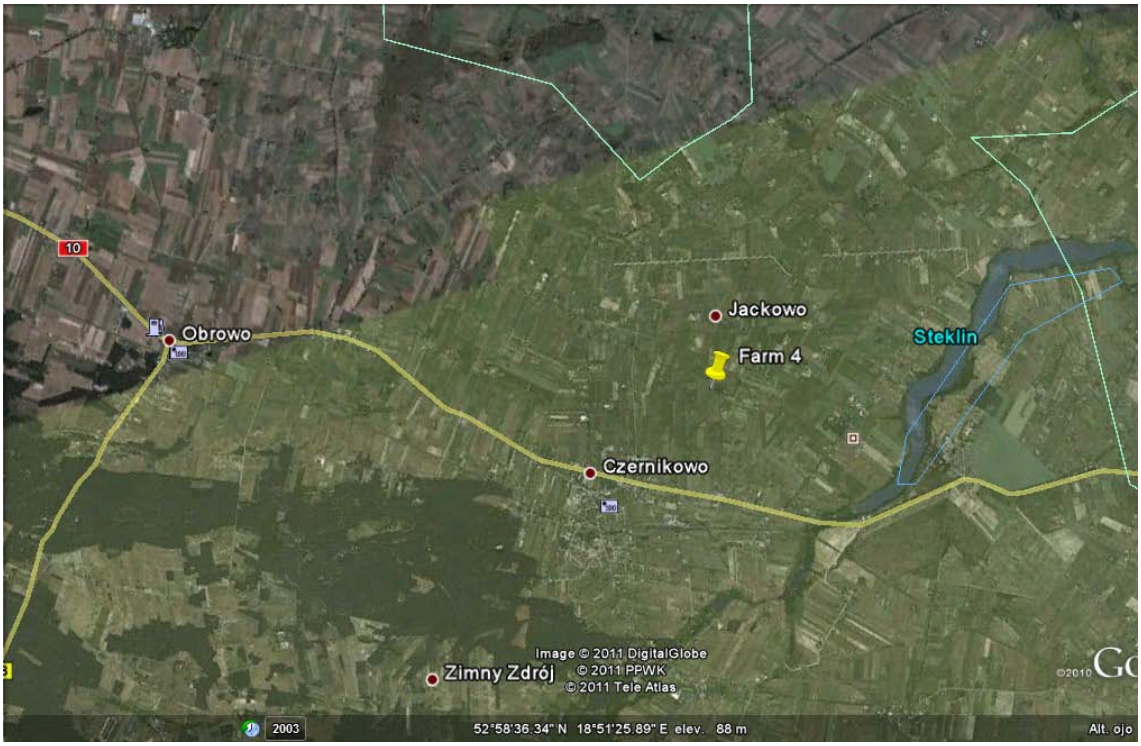
	-60 piglets -50 for slaughtering
Primary production compartments	Ident. Of the fields and crops
Input in primary production compartments	Crop protection: -Herbicides: 0,40723 l/ha -Herbicides solid: 0,00525 kg/ha -Fungicides: 0,26637 l/ha Sources of fertilizers: Polifoska, ammonium nitrate, ammonium sulfate, manure.
Inputs in secondary production compartments	They bought 6 Tn of concentrate and 20 Tn of soybean.
Output primary production compartments	Winter crops: -27 ha wheat→150Tn -6 ha barley→110Tn Spring crops: -20,7 ha barley→80tn -32 colza→268Tn
Growth of herd	They sold 6 pigs, each one weight 120 kg.
Family labour	Plant production: 517,8 hrs/year Animals: 1600 hrs/year Work in taller: 182,5 hrs/year



Farm 3. Source: Google earth.

Farm 4

Information group	Type of information
Farm 4	
General farm data	N 52º 57.636´ E 018º 58.845´
Type of production	Production mixed and conventional
Demographic strucute of the household	Owner is between 50-60 years old and he has agronomical studies. There are 4 adults living in the farm.
	They have 2 people working temporary 1 months.
Primary production	Arable land: 18 ha Meadows: 5 ha Build-up area: 0,30 ha Lake: 0,5 ha
Secondary production	Cows: -10 milk -6 calves Pigs: -3 sows -15 slaughtering -26piglets and 15 wildpiglets.
Input in primary production compartments	Crop protection: -Herbicides: 3,20 l/ha -Fungicides:0 16 l/ha Sources of fertilizers: polifoska, nitro chalk, manure and dung.
Inputs in secondary production compartments	Concentrated 400 kg/month
Output primary production compartments	Winter crops: -Triticale 7ha→31,5Tn Spring crops: -Barley 4ha→18Tn -White beet 4ha→100Tn -Mixed 10ha→12Tn
Growth of herd	They produce 42000ltrs of milk. They sold 2 cows, 6 calves and 70 pigs for slaughter.
Family labour	Plant production: 1200 hrs/year Work in taller: 365 hrs/year Animals: 1000 hrs/year

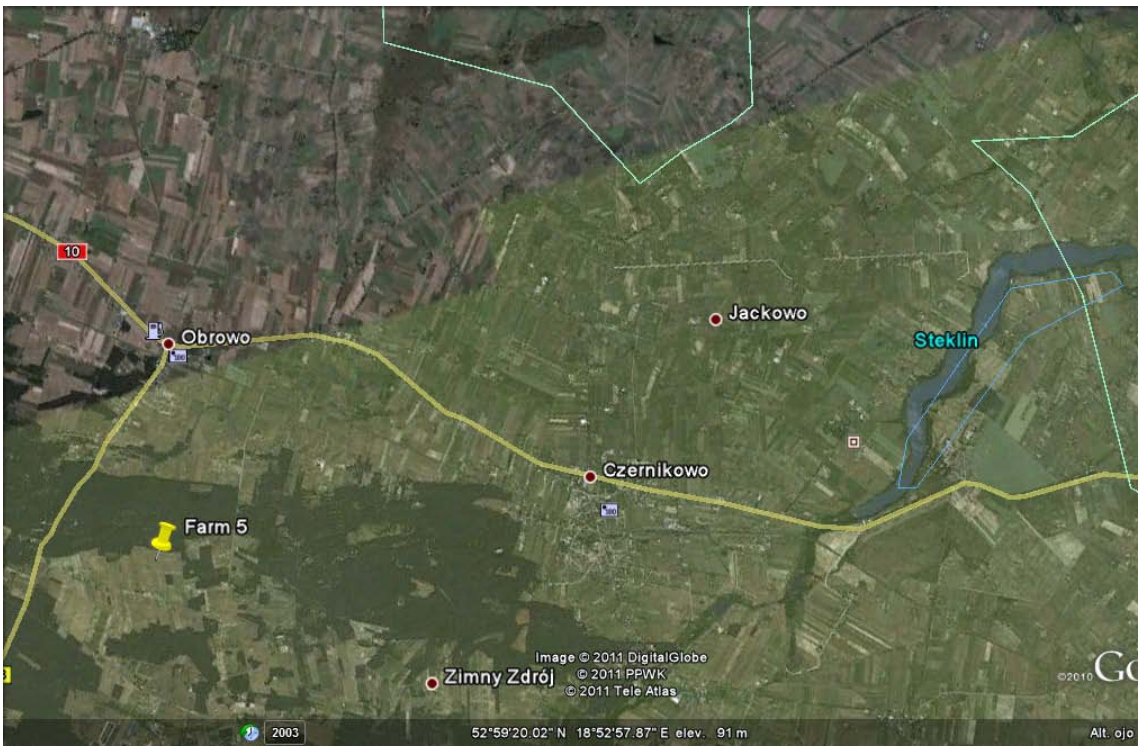


Farm 4. Source: Google earth.

Farm 5

Information group	**Type of information**
Farm 5	
General farm data	N 52º 57.636´ E 018º 52.084´
Type of production	Their production is mixed and conventional
Demographic structure of the household	The owner is between 50-60 years old and he has agronomical school studies. There are 6 adults and 1 kids living in the farm.
	They have one person working fulltime.
Primary production	Arable land: 13,54 ha Forest:1,5 ha Build-up area: 0,4 ha
Secondary production	Pigs:85
Input in primary production compartments	Crop protection: -Herbicides:0,61 l/ha -Herbicides(solid):0,2Kg/ha

	Sources of fertilizers: Urea, Polifoska, ammonium nitrate, ammonium sulfate.
Inputs in secondary production compartments	-Treatments: 1500zl -Veterinary: 1200zl
Output primary production compartments	Winter crops: -2,15 ha triticale→10Tn -2,5 ha rye→5Tn -1,84ha barley→7Tn Spring crops: -1,23 ha Lupin→1,5Tn -1,32ha Corn→9Tn
Growth of herd	They sell 80 pigs. 8800 kg all animals
Family labour	Plant production: 300 hrs/year Animals: 730 hrs/year Work in taller: 135 hrs/year



Farm 5. Source: Google earth.

Farm 7

Information group	Type of information
Farm 7	

General farm data	N 53º 01.195´ E 018º 55.355´
Type of production	Their production is mixed and conventional
Demographic structure of the household	The owner is between 40-50 years old and he has agronomical school studies. There are 5 adults
Primary production	Arable land: 73 ha Build-up area: 2 ha
Secondary production	Pigs: 40 cattle: 20
Input in primary production compartments	Crop protection: -Herbicides:2,84 l/ha -Herbicides(solid):0,01Kg/ha -Fungicides:0,47l/ha Sources of fertilizers: Urea, Polifoska, ammonium nitrate, manure.
Inputs in secondary production compartments	
Output primary production compartments	Winter crops: -35 ha wheat→75Tn Spring crops: -20 ha barley→10,56Tn -18 corn→125Tn
Growth of herd	They sell 20cows. 16000 kg per all animals
Family labour	Plant production: 600 hrs/year Animals: 2920 hrs/year Work in taller: 20 hrs/year

Farm 7. Source: Google earth.

Farm 8

Information group	Type of information
Farm 8	
General farm data	N 53º01.401´ E 018º 55.287´
Type of production	Their production is mixed and conventional
Demographic structure of the household	The owner is between 50-60 years old and he has tradel school studies. There are 5 adults and 1 kids living in the farm.
	They have 1 person working temporary 2 months.
Primary production	Arable land: 45,5 ha Meadows: 4,5ha Build-up area: 0,5 ha
Secondary production	Pigs: 950 Cattle: 24 Goat: 3
Input in primary production compartments	Crop protection: -Herbicides:1,98 l/ha

	-Herbicides(solid):0,07Kg/ha -Fungicides:0,54Kg/ha Sources of fertilizers: Urea, lubofoska, ammonium nitrate, ammonium sulfate, manure, poliwap.
Inputs in secondary production compartments	-treatments: 900zl -Veterinary: 4800zl
Output primary production compartments	Winter crops: -11,5 ha triticale→40Tn -6 ha wheat→40Tn Spring crops: -22 ha barleyt→60Tn -6ha leguminous plants→Tn
Growth of herd	They sell 1300 pigs→145Tn, 10 cows→ 7,5Tn. 1100 Piglets→ 23Tn.
Family labour	Plant production: 960 hrs/year Animals: 1825 hrs/year Work in taller: 10 hrs/year

Farm 8. Source: Google earth.

Farm 13

Information group	Type of information
Farm13	
General farm data	N 52º57.065´ E 018º 43.396´
Type of production	Their production is mixed and conventional
Demographic structure of the household	The owner is between 40-50 years old and he has agronomical school studies. There are 2 adults and 3 kids living in the farm. They have 1 person working temporary seasonally.
	Problems of flooding
Primary production	Arable land: 27 ha Meadows: 6ha Forest:1 ha Build-up area: 0,5 ha
Secondary production	Cows: 25 Cattle: 25
Input in primary production compartments	Crop protection: -Herbicides(solid):0,13Kg/ha Sources of fertilizers: Urea, ammonium nitrate, manure.
Inputs in secondary production compartments	-Treatments: 1500zl -Veterinary: 25000zl
Output primary production compartments	Winter crops: -10 ha triticale→-Tn -10 ha whea→-Tn -3 ha rye→-Tn Spring crops: -4ha Corn→80 Tn
Growth of herd	They sell 15cows→9000 kg all animals
Family labour	Plant production: 1200 hrs/year Animals: 1460 hrs/year Work in taller: 365 hrs/year

Farm 13. Source: Google earth.

Farm 14

Information group	Type of information
Farm14	
General farm data	N 52º 57.065´ E 018º 44.882´
Type of production	Their production is mixed and conventional
Demographic structure of the household	The owner is between 40-50 years old and he has tradel school studies. There are 3 adults and 1 kids living in the farm.
	Problems of flooding
Primary production	Arable land: 61,58 ha Meadows: 20,78ha Forest:10,5 ha Build-up area: 0,45 ha
Secondary production	Cows: 1 Pigs: 540 Cattle: 27 Sheeps: 110
Input in primary production compartments	Crop protection:

	-Herbicides:0,9 l/ha -Herbicides(solid):0,01Kg/ha Sources of fertilizers: Polifoska, ammonium nitrate, ammonium sulfate, manure.
Inputs in secondary production compartments	-hernia: 200zl -Veterinary: 17000 zl
Output primary production compartments	Winter crops: -12,5 ha triticale→37,5Tn -15 ha wheat→75Tn Spring crops: -2,64 ha wheat→10,5Tn -31,44 mixed→94,3Tn -5ha Corn→125 Tn
Growth of herd	They sell 160 sheeps. 4500 kg all animals
Family labour	Plant production: 600 hrs/year Animals: 2920 hrs/year Work in taller: 20 hrs/year

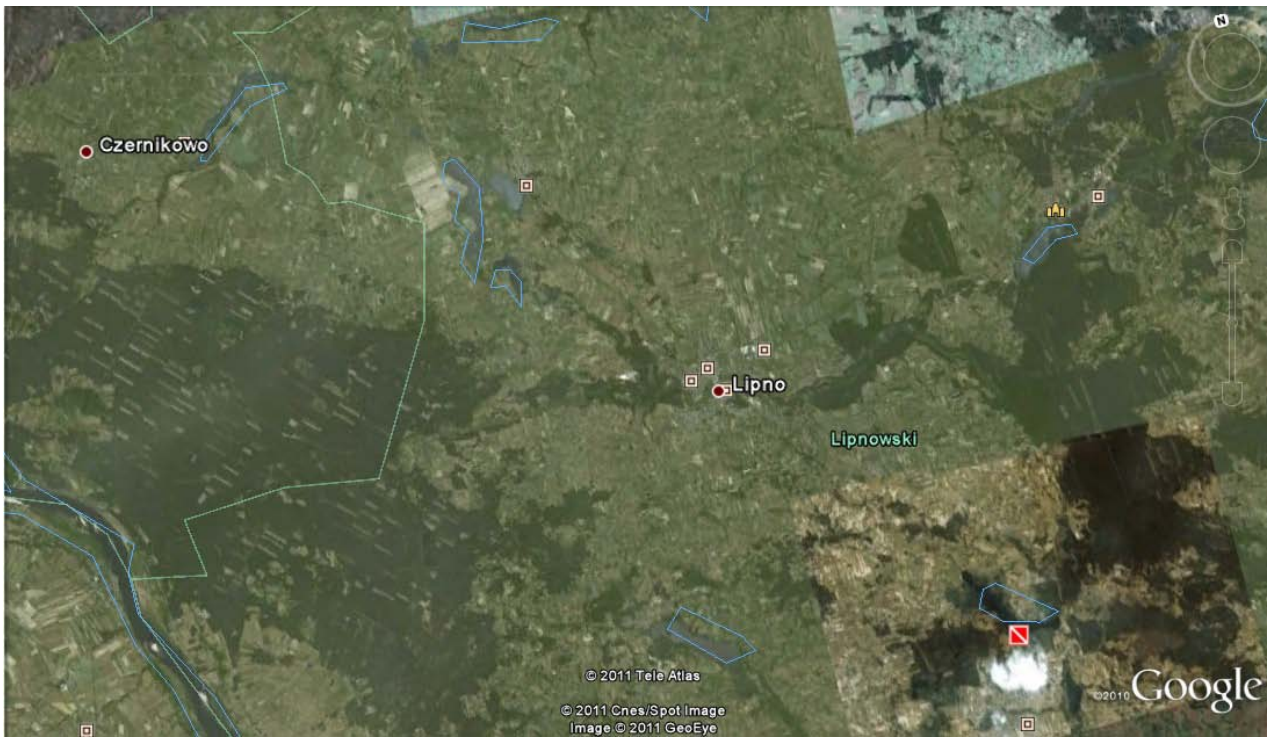
Farm 14. Source: Google earth.

Farm 15

Information group	Type of information
Farm15	
General farm data	N 53º01.029´ E 018º55.355´
Type of production	Their production is mixed and conventional
Demographic structure of the household	The owner is between 50-60 years old and he has trade school studies. There are 2 adults and 1 kids living in the farm.
	They have one person working temporary.
Primary production	Arable land: 47,5 ha Meadows:14 ha Build-up area: 1,5 ha
Secondary production	Cows:70 Horses:3 Calves:50
Input in primary production compartments	Crop protection: -Herbicides:1,24 l/ha -Herbicides (solid):0,06Kg/ha -Fungicides:0,08l/ha Sources of fertilizers: Urea, Polifoska, ammonium nitrate, ammonium sulfate, manure.
Inputs in secondary production compartments	(no data)
Output primary production compartments	Winter crops: -8 ha triticale→48Tn Spring crops: -7,7 ha barley→40Tn -3,5ha oat→10Tn -28,3ha Corn→990Tn
Growth of herd	They sell 7 cows.42800 kg all animals and 45600 litres of milk.
Family labour	Plant production: 1750 hrs/year Animals: 2920 hrs/year Work in taller: 1000 hrs/year

Farm 15. Source: Google earth.

Farms from Lipno´s area



Lipno and Czernikowo. Source: Google earth.

Farm 1

Information group	Type of information
Farm 1	
General farm data	N 52º 43´39´´ E 19º 25´44´´
Type of production	Their production is animal and conventional
Demographic structure of the household	The owner is between 40-50 years old and he has trade school studies. There are 2 adults living in the farm..
Primary production	Arable land: 23.70 ha Meadows: 10,50 ha Forest: 0.3 ha Build-up area: 0.5 ha
Secondary production	Cows: - 24 milk cows - 32 cattle

Input in primary production compartments	Crop protection: -Herbicides:1.29 l/ha Sources of fertilizers: Urea, polifoska, ammonium nitrate, ammonium sulfate, manure, ecolist.
Inputs in secondary production compartments	-Multimlek 38 extra: 2.5 tn -Otrevy pszenne: 8 tn -Sambul-opas: 1.5 tn -Revision: 250 zl -Veterinary: 200 zl
Output primary production compartments	Winter crops: -6 ha rye→18Tn -8 ha triticale→32Tn Spring crops: -4,7 ha barley→10Tn -5 mixed→15Tn - 10,5 meadows
Growth of herd	They sold 80,000 l of milk and 12 cattle (7,200 kg)
Family labour	Plant production: 1,440 hrs/year Animals: 2,190 hrs/year Work in taller: 20 hrs/year

Farm 1. Source: Google earth.

Farm 6

Information group	Type of information
Farm 6	
General farm data	*(Gps no data available)*
Type of production	Their production is animal and conventional
Demographic structure of the household	The owner is between 50-60 years old and he has agronomical school studies. There are 2 adults and 2 kids living in the farm.
Primary production	Arable land: 13.7 ha Forest: 5.14 ha Build-up area: 1 ha
Secondary production	Pigs: 30 Chicken: 10
Input in primary production compartments	Crop protection: -Herbicides:1.59 l/ha Sources of fertilizers: Polifoska, ammonium nitrate, ammonium sulfate.
Inputs in secondary production compartments	-Schauman: 3 tn -Veterinary: 1,000 zl
Output primary production compartments	Winter crops: -1.82 ha rye→9Tn -4.75 ha triticale→15Tn -0.7 ha wheat→ Spring crops: -1.8 ha barley→8Tn -3.11 mixed→15Tn
Growth of herd	They sell 100 animals per year. 120 per kg/ animal
Family labour	Plant production: 600 hrs/year Animals: 1,460 hrs/year Work in taller: 20 hrs/year

(No GPS data available)

Farm 9

Information group	Type of information
Farm 9	
General farm data	N 52º 44´48´´ E 19º 30´59´´
Type of production	Their production is mixed and conventional
Demographic structure of the household	The owner is between 30-40 years old and he has trade school studies and receiving knowledge from parents. There are 2 adults and 3 kids living in the farm.
Primary production	Arable land: 10 ha Meadows: 3 ha Forest: 5 ha Build-up area: 0.42 ha
Secondary production	Goose: 10,000
Input in primary production compartments	Crop protection: -Herbicides: 2.44 l/ha Sources of fertilizers: Polifoska, ammonium nitrate,manure.
Inputs in secondary production compartments	-Starter: 50 tn -Oat: 100 tn -Mixed: 100 tn -Triticale: 30 tn -Veterinary: grafting 1,000 zl ; studio vatu 500 zl; others: 2,000 zl.
Output primary production compartments	Winter crops: -1 ha wheat→4Tn -3 ha triticale→10Tn -2 ha barley→7Tn Spring crops: -4 ha oat→
Growth of herd	They sold 9,700 animals (60 tn)
Family labour	Plant production: 900 hrs/year Animals: 2,555 hrs/year Work in taller: 10 hrs/year

Farm 9. Source: Google earth.

Farm 10

Information group	Type of information
Farm10	
General farm data	N 52º 44´41´´ E 19º 27´13´´
Type of production	Their production is mixed conventional
Demographic structure of the household	The owner is between 40-50 years old and he has trade school studies. There are 5 adults and 2 kids living in the farm.
	They have 2 people working full time.
Primary production	Arable land: 64.9 ha Forest: 7.49 ha Build-up area: 0.93 ha
Secondary production	Pigs: 30 Cows: 12 cattle Chicken: 20 Horses: 1
Input in primary production compartments	Crop protection: -Herbicides:3.54 l/ha -Insecticides: 1.36 l/ha

	Sources of fertilizers: Polifoska, ammonium nitrate, ammonium sulfate, manure, suprofos.
Inputs in secondary production compartments	-Concentrat: 5 tn -Revision: 200 zl -Veterinary: 1,200 zl
Output primary production compartments	Winter crops: -18,72 ha wheat→60Tn -2 ha triticale→10Tn Spring crops: -7,24 ha barley -2.75 ha wheat -3.34 ha mixed - 3.09 ha meadows - 10.4 ha colza→30Tn - 9.43 ha legominous plants - 1.20 ha corn - 6.23 ha red shamrock - 0.32 ha orchard
Growth of herd	No data available
Family labour	Plant production: 1,920 hrs/year Animals: 2,190 hrs/year Work in taller: 20 hrs/year

Farm 10. Source: Google earth.

Farm 11

Information group	Type of information
Farm 11	
General farm data	N 52º 42´19´´ E 19º 24´44´´
Type of production	Their production is mixed and conventional
Demographic structure of the household	The owner is between 30-40 years old and he has trade school studies. There are 3 adults and 2 kids living in the farm.
	They have people working: 1 full time; 1 temporary
Primary production	Arable land: 12.17 ha Forest: 1.38 ha Build-up area: 0.5 ha
Secondary production	Pigs: - 32 sows - 750 piglet
Input in primary production compartments	Crop protection: -Herbicides: 1.28 l/ha Sources of fertilizers: Urea, ammonium nitrate, manure.
Inputs in secondary production compartments	-Starter: 100 -TR: 135 - Premix: 1 -Revision: 9,000 zl -Veterinary: 4.300 zl
Output primary production compartments	Winter crops: -5 ha rye-→10Tn -4 ha triticale→16Tn Spring crops: -3 ha oat→9Tn
Growth of herd	They sell 750 animals (66 tn)
Family labour	Plant production: 60 hrs/year Animals: 1,095 hrs/year Work in taller: 20 hrs/year

Farm 11. Source: Google earth

Farm 12

Information group	Type of information
Farm 12	
General farm data	N 52º 44´48´´ E 19º 30´59´´
Type of production	Their production is plant and conventional
Demographic structure of the household	The owner is between 30-40 years old and he was in courses and also he received information from his parents. There are 4 adults and 2 kids living in the farm..
	They have people working temporary
Primary production	Arable land: 55
Secondary production	
Input in primary production compartments	Crop protection: -Herbicides:0.91 l/ha

	Sources of fertilizers: Urea, polifoska, ammonium nitrate, ammonium sulfate, potassium salt, eKolist zbozowy, ecolist rzepakd.
Inputs in secondary production compartments	
Output primary production compartments	Winter crops: -10 ha wheat→10Tn -15 ha triticale→18Tn Spring crops: -20 ha colza→64Tn -10 mixed→10Tn
Growth of herd	
Family labour	Plant production: 1,440 hrs/year Work in taller: 480 hrs/year

Farm 12. Source: Google earth.

4 Results

All data obtained in holdings which were visited are represented in following pages where we can find summary tables of every aspect of the farms.

There are also some graphics which represent matter and energy flow through each farm. All these graphics were designed in excel sheets according to Tellarini´s model. This model was explained in scientific approach and methods.

It is important to explain the model of matter and energy flow. There are some boxes where we can find different kind of inputs and outputs.

Inputs:

- **Initial stock produced on farm (seeds):** In this box it is possible to find inputs according to initial amount of seeds that holders have at the beginning of the season.(Kg/ha & Gj/ha)

- **Initial stock produced on farm (animals):** In this box is possible to find inputs according to initial amount of animals that holders have at the beginning of the season. (Kg/ha & Gj/ha)

- **Initial stock produced by agriculture:** This box includes animals and crops that agriculture holders bought at the beginning of the year. (Kg/ha & Gj/ha)

- **Initial stock produced by other sectors:** This box includes inputs related with crop protection products, herbicides, fertilizers... In case of fertilizers, elements which are going to be added to the plant are in an inorganic way so they support the development of the plant but not giving energy directly. That´s because these products are going to enter in the cycle like biomass, not like a direct provided of energy.(Kg/ha)

- **External input produced by other sectors:** Here it is possible to find information about inputs from machinery, electricity, human work, oils and fuels, etc...

- **External input produced by agriculture:** Inputs concerning to animals feeding obtained from agriculture. (kg/ha & Gj/ha)

Outputs:

- **Market of products:** These outputs include everything that holders can obtain and can sell from their holdings.

- **Final stock produced on farm:** In this box is included all animals and crops that holders keep at the end of the season to reuse it at the beginning of the next one.

Seed material

	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Farm 6	Farm 7	Farm 8	Farm 9	Farm 10	Farm 11	Farm 12	Farm 13	Farm 14	Farm 15
Own															
Kg/ha	134,9	121,18	81,68	70	74,79	164,3	152	67,31	114,55	41,54	118,88	72,07	75,36	20,55	11,11
Gj/ha	2,18	1,99	1,31	1,13	1,23	2,69	2,49	1,07	1,89	0,67	1,92	1,19	1,21	0,33	0,19
Purchase															
Kg/ha	0	0	38,46	80,32	54,35	0	0	76,92	0	40,5	39,63	36,94	95,65	71,2	69,05
Gj/ha	0	0	0,63	1,35	0,87	0	0	1,27	0	0,66	13,88	0,6	1,49	1,66	1,26

Fertilizers:

	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Farm 6	Farm 7	Farm 8	Farm 9	Farm 10	Farm 11	Farm 12	Farm 13	Farm 14	Farm 15
Mineral fertilizers															
Nitrogen															
Kg/ha	33,37	85,15	174,15	62,78	54,22	30,24	186,67	44,13	47,12	25,24	69,16	103,59	46,09	48,62	124,76
Gj/ha	2,93	7,48	15,31	5,52	4,77	2,66	16,41	3,88	4,14	2,22	6,08	9,11	4,05	4,27	10,97
Phosphorus															
Kg/ha	13,71	14,69	71,20	60	3,22	0,36	40	10,15	21,72	16,36	0	28,83	0	10,17	*38,1*
Gj/ha	0,36	0,39	1,88	1,58	0,09	0,01	1,05	0,27	0,57	0,43	0	0,76	0	0,27	*1*
Potasium															
Kg/ha	20,57	14,69	106,8	60	4,84	0,54	60	10,15	32,57	24,54	0	59,46	0	15,26	57,14
Gj/ha	0,22	0,15	1,12	0,63	0,05	0,01	0,63	0,11	0,34	0,26	0	0,62	0	0,16	0,6
Magnesium															

Kg/ha	0	0	0	0	0	0	0	0	0	0	0	87,57	0	0	0
Gj/ha	0	0	0	0	0	0	0	0	0	0	0	0,12	0	0	0
Calcium															
Kg/ha	0	0	0	0	0	0	0	0	0	0	0	16,22	0	0	0
Gj/ha	0	0	0	0	0	0	0	0	0	0	0	0,02	0	0	0
Natural fertilizers															
Nitrogen															
Kg/ha	57,14	12,24	20,59	59,45	0	0	2,67	57,69	77,36	2,6	54,03	0	36,23	30,52	47,62
Gj/ha	5,02	1,08	1,81	5,23	0	0	0,23	5,07	6,8	0,23	4,75	0	3,19	2,68	4,19
Phosphorus															
Kg/ha	14,86	3,18	5,35	31,20	0	0	0,69	15	20,11	0,68	14,05	0	9,42	7,93	12,38
Gj/ha	0,39	0,08	0,14	0,82	0	0	0,02	0,40	0,53	0,02	0,37	0	0,25	0,21	0,33
Potasium															
Kg/ha	66,29	14,20	23,8	64,17	0	0	3,09	66,92	89,74	3,01	62,68	0	42,03	35,4	55,24
Gj/ha	0,69	0,15	0,25	0,67	0	0	0,03	0,7	0,94	0,03	0,66	0	0,44	0,37	0,58
Magnesium															
Kg/ha	0	0	0	49,78	0	0	0	0	0	0	0	0	0	0	0
Gj/ha	0	0	0	0,07	0	0	0	0	0	0	0	0	0	0	0
Calcium															
Kg/ha	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0
Gj/ha	0	0	0	0,02	0	0	0	0	0	0	0	0	0	0	0

Crop protection:

	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Farm 6	Farm 7	Farm 8	Farm 9	Farm 10	Farm 11	Farm 12	Farm 13	Farm 14	Farm 15
Herbicides (l)															

L/ha	1,94	0,98	1,56	3,2	0,61	1,64	2,84	1,98	--------	3,7	2,74	0,9	0	0,9	1,24
Gj/ha	0,51	0,26	0,41	0,84	0,16	0,43	0,75	0,52	--------	1,31	0,72	0,24	0	0,24	0,33
Herbicides (kg)															
Kg/ha	0,02	0	0,015	0	0,2	0	0,01	0,07	--------	0,97	0	0	0,13	0,01	0,06
Gj/ha	0,01	0	0,005	0	0,05	0	0	0,02	--------	0,34	0	0	0,04	0	0,02
Fungicides															
Kg/ha	0	0	2,3	0,16	0	0	0,47	0,54	--------	0	0	0	0	0	0,08
Gj/ha	0	0	0,27	0,02	0	0	0,05	0,06	--------	0	0	0	0	0	0,01

Crops:

	Farm 1	**Farm 2**	**Farm 3**	**Farm 4**	**Farm 5**	**Farm 6**	**Farm 7**	**Farm 8**	**Farm 9**	**Farm 10**	**Farm 11**	**Farm 12**	**Farm 13**	**Farm 14**	**Farm 15**
Purchase															
Kg/ha	0	0	0	0	270,8	0	732,53	0	12.486,43	64,91	0	14.150,63	947,82	558,84	219,05
Gj/ha	0	0	0	0	4,6	0	11,85	0	206,03	1,1	0	244	15,94	9,04	3,74
Own															
Kg/ha	5.697	6.493,2	0	8,169.6	6.105,7	6.719	8.397,33	9.506,69	3.132,46	3.866,02	6.801,15	288,28	1.303,3	7.423,46	7.303,2
Gj/ha	92,002	105,02	0	131,1	76,2	108,46	133	153,05	50,75	48,81	110,22	4,73	16,8	99,88	86,5
For sale															
Kg/ha	0	0	9.544,9	0	0	0	0	0	0	1.616,25	0	0	0	0	0
Gj/ha	0	0	171,51	0	0	0	0	0	0	30,45	0	0	0	0	0
Fodder															
Kg/ha	0	0	3.173,86	0	0	0	0	0	0	0	0	0	0	0	0
Gj/ha	0	0	51,18	0	0	0	0	0	0	0	0	0	0	0	0

Oils and fuels:

	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Farm 6	Farm 7	Farm 8	Farm 9	Farm 10	Farm 11	Farm 12	Farm 13	Farm 14	Farm 15
Diesel															
l/ha	114,3	42,84	0,82	120	77,37	109,17	133,33	96,15	135,72	90,87	78,17	90,09	101,45	101,72	19,05
Gj/ha	5,46	2,05	0,04	5,73	3,7	5,21	6,37	4,6	6,5	4,34	3,73	4,3	4,85	4,86	0,91
Oil															
l/ha	0,57	3,06	1,17	4	6,6	10,92	1,4	1,15	0	2,07	4,75	0,9	2,9	1,07	0,95
Gj/ha	0,03	0,15	0,05	0,2	0,31	0,521	0,07	0,05	0	0,099	0,22	0,04	0,14	0,05	0,04
Petrol															
l/ha	57,14	0	11,7	0	0	0	2,7	1,9	0	12,98	57,64	0	0	2,03	0
Gj/ha	2,73	0	0,55	0	0	0	0,13	0,09	0	0,6	2,75	0	0	0,09	0

Human work:

	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Farm 6	Farm 7	Farm 8	Farm 9	Farm 10	Farm 11	Farm 12	Farm 13	Farm 14	Farm 15
Gj/ha	0,25	0,54	0,06	0,25	0,18	0,27	0,11	0,13	0,45	0,13	0,21	0,08	0,21	0,08	0,22

Electricity and others:

	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Farm 6	Farm 7	Farm 8	Farm 9	Farm 10	Farm 11	Farm 12	Farm 13	Farm 14	Farm 15
Electricity (Gj/ha)	1,3	0	0	0	6,02	3,96	0,97	13,82	4,99	1,24	8,63	1,3	2,7826	0,74	7,13
Machinery (Gj/ha)	1,8	4,1	1,7	4,1	5,59	3,6	1,26	2,73	3,2	2,68	4,22	1,77	4,39	0,77	1,32
Gas (Gj/ha)	0	0,51	0,1	0,22	0	0	0	0	4,59	0	0	0	0	0	0
Wood (Gj/ha)	2,65	4,53	1,62	3,71	8,96	10,11	2,47	0	12,57	0,6	0	8,34	71,01	1,88	0,74
Coal (Gj/ha)	4,2	5,12	0,98	1,67	20,24	3,43	1,12	0,81	0	0,27	9,05	0	3,03	0,85	1,66

5 Discussion

Seed material

It is possible to see that 5 from 15 holdings don´t buy seeds to cultivate. Some agriculture holders prefer to keep their production from one season to the next. This is good if crop production is not destined to be sold in market but for animal feeding. If they have fields but they are going to use its final production to feed animals is obvious that they can keep seeds to cultivate next year because seed market is not their business in these farms.

In the 10 remaining farms there is a varied input of seeds according to its amount. There are some farmers that buy a similar amount of seeds than their own seeds and another kind of holdings where is possible to see that they have to buy a large percentage of seeds than they use. As an example of the last observation are farms 14 and 15.

Some of these farms show to be self-sufficient because they don´t need to buy seeds. However it would be good for all the agriculture holders to buy an extra amount of seeds to obtain extra production and in this way maybe is possible to have more incomes.

Every short period of time is possible that new varieties appear so it is important to re use production but also buy something new each couple of years. By this way, maybe is possible to increase its performance. Anyway, it is always good to make soft changes to develop agriculture holders.

Fertilizers

There are two kinds of fertilizers: mineral and natural. Mineral fertilizers are these artificial products which add elements to the ground. In every farm it is possible to check that they use mineral fertilizers with nitrogen. Adding nitrogen to the ground is something normal but it should be in a controlled way. As it´s explained in pages before, in Poland there is a big problem because of the amount of nitrogen in the ground. Some evidences show that watercourses and Baltic Sea are not so healthy because of the amount of these substances. High level of nitrogen is one of these problems.

Because of in Poland agriculture holdings structure is very often mixed production, almost every holding use natural fertilizers like manure. Manure is a natural fertilizer with high contents of nitrogen, potassium and phosphorus. Only three holdings don´t use natural fertilizers and in two of these cases is because in fact they are not mixed holdings.

The contribution with natural phosphorus is remarkable being in some cases similar contribution of natural fertilizers with mineral fertilizers. However, phosphorus addition through mineral fertilizers is important and also it is important to pay attention because there are also high levels of this element in watercourses and grounds.

Addition of potassium generally takes place through natural fertilizers. In almost all the farms, quantity of potassium added by fertilizers is from manure. Sandy soils, like in this region, need a good quantity of potassium. That´s because this element can disappear easily from the ground due to rainfall water.

Another macroelements like magnesium and calcium are not added neither in natural fertilizers nor in mineral ones. Little amounts of magnesium and calcium are necessary to make our production increase its value.

Farm 3 is one of the farms that use more quantity of mineral fertilizer. It is normal because is one of the two holdings that sell crops in a large amount adding to animal production. But it is also interesting to check that is not one of the top natural fertilizer users. In this case it would be good to use a more balanced addition of mineral and natural fertilizers.

Farm 1, farm 4 and farm 9 are using a good amount of natural fertilizers. Farm 1 and 4 are farms of nearly 20 ha with a normal animal production. They also add normal-high quantity of mineral fertilizers so even if it is balanced, it would be good to use less amount of fertilizers to prevent possible problems of contamination on the ground and water courses.

It is interesting to pay attention in farm 9. This farm is a small farm of 10 ha distributed in fields of 3 and 2 ha of different crops. Its main production is animal (10.000 gooses) and also they buy a big part of the animals food so it is not necessary to add these amounts of mineral and natural fertilizers. It would be important to decrease this addition of fertilizers because this farm is close to a water course so it is so dangerous for environment.

There are other farms closer to water courses which maybe they have big problem of nutrient leaching because of floods, like farms 13 and 14, and maybe they use a large quantity of fertilizers which is not good (but for them is necessary) but even if they need more than others, there are still holders that add more fertilizers than them.

Crop protection

Usage of herbicides is so extended but mainly liquid herbicides. Is not common to see the usage of fungicides and maybe it is because of the climate. It is true that climate is one of the bad points of Poland, talking obviously from agriculture interests, but it is also good because with this weather is not probable to create the perfect atmosphere for fungi and other kind of diseases.

There is not the same amount of diseases like in other warmer countries but it is also true that there is a big lack of natural barriers. Natural barriers are good to stop diseases between fields of crops. Also the lack of mountains makes this target more difficult. In the end, natural barriers are natural elements like mountains and threes which make impossible or at least more difficult the pass of animals and other kind of vectors to spread diseases from one crop to another.

Liquid herbicides are more interesting for holders because it is easier its application on the fields and also because it is a little bit easier its preparation. It is possible is more efficient and also cheaper but there are many different factors that can change from one farm to the other. Fertilizers depend of the crop and the soil, so crop protection depends of what kind of protection it is necessary to buy and how strong it has to be.

There are some farms with high use of crop protection like farms 7, 10 and 11. In the first two cases there are a high variety of crops in each farm so it is understandable because they have to prevent inappropriate crops which can be harmful for production.

In farm 11 it is not so appropriate to use a quantity of herbicides because their main aim in this farm is animal production and also they have 12, 17 ha, so is not so large. It doesn´t mean that in this farm they can´t use herbicides, it is just that it would be better to use less quantity. If they achieve this aim is possible that their product can be more valuable and maybe they can sell it more expensive.

There is another important topic related with crop protection, and this is insecticides. There are not enough data of insecticides but it is sure that like in fungi case, problems with insects are no so intense like in other warm countries.

Crops

Crop production is different in Poland from other crop production system from other countries. In this case it is possible to check that agriculture holdings are mixed. It is difficult to find a holding only dedicated to crop production.

There can be more than one reason for this situation:

- Meat production is more attractive for holders because they can sell it better. There is a special increase of meat claim in last times.
- It is good to have a mixed holding because in polish hard winters crop production can be stopped during months.

According to data obtained from our visits it is possible to see that only two holdings obtain crops to sell, which is significant between 15. These farms are farm 3 and farm 10.

The other farms, because of their mixed production, everything they obtain from crops is going to be sent to livestock. That is a big difference between this system and Spanish system for example.

Eight of these farms buy extra crops to feed their animals and between these holdings is important to remark two of them: Farm 9 and farm 12. In these farms they buy big quantity of crops for their animals and it is obvious because in farm 9, for example, they have 10.000 gooses.

If we pay attention only in crops is important to mention farm 13 and farm 14. In these farms they have big problems with floods because of their proximity to the river. It is possible to check in tables that even if they have good fields (talking about length), they can´t achieve good levels of production. They were thinking of selling their fields because it was impossible to obtain a regular production every year.

Oils and fuels

In this field there are data related directly with agricultural production and also with diary life of holders and their families.

If we talk about diesel, at least the half of the holdings consume more than 100 litres/ha. This can be normal because most of them are mixed holdings and animal production consumes more energy. This fact can be demonstrated because the two holdings dedicated to crop production are between the farms with less amount of energy consumed, which is obvious.

Talking about petrol there are only two remarkable cases. Farm 1 and farm 11. This last farm can be normal because they have a high production of animals but in farm 1 it can be due to old machinery which works with petrol instead of diesel.

Human work

In this point there are some curious things and maybe is related with data obtained from farmers, because maybe in this field it was not so exact.

Also these differences can be related with level of mechanization, because if this topic is developed considerably is possible to make easier farmer work.

One example of these differences is between farm 14 with 62 ha of arable land and a large animal production and farm 2 with 8 ha of arable land and short animal production.

In farm 2 it is possible to see 0.54 Gj/ha and in farm 11 0.08 Gj/ha.

Electricity and others

Like in other fields, electricity, machinery and other aspects can be so different between farms. Farm 5 is one remarkable holding because they have a large spending of energy. Electricity, machinery and gas are normal, which means that is normal to see this energy in agriculture but there is an important point to pay attention: coal and wood. These sources of energy has to disappear from agriculture as soon as possible because they are fossil sources and also so dirty with environment.

There are farms like farm 5 that obtain only through coal more energy than machinery, gas, electricity, all together in other farms and this is not good for environment. But the real problem is in all farms, because almost all of them obtain energy from coal and wood, and these amounts of energy are not precisely small.

Like in human work, mechanization can make the energy requirement of one farm very large. The most important thing to see if one farm is developed in this point is not only the amount of energy that they use but the nature of this energy.

6 Conclusions

a) Polish agriculture is growing but is necessary to create enterprises and cooperatives to give the chance to small holders to improve their incomes.

b) If Poland is powerful in some crops it should be good to create a registered brand, appellation of origin which can make more interesting polish crops under this appellation.

c) Education of farmers should be better, like in other countries, because they have in their hands a huge responsibility and also they can be the first ecologist. With a good education it could be possible.

d) Poland and its Government should suggest ecological farms, to make this way of agriculture attractive to holders. If this happened, it would be good to find solutions to make these products affordable for population. This is a big problem in many countries.

e) Poland should start to extend more its exportations of agriculture products.

f) Polish farmers should decide to change to intensive producers of meat or crops. But not always both of them at the same time.

g) It is very important to change gradually sources of energy from fossil fuels to renewable energy.

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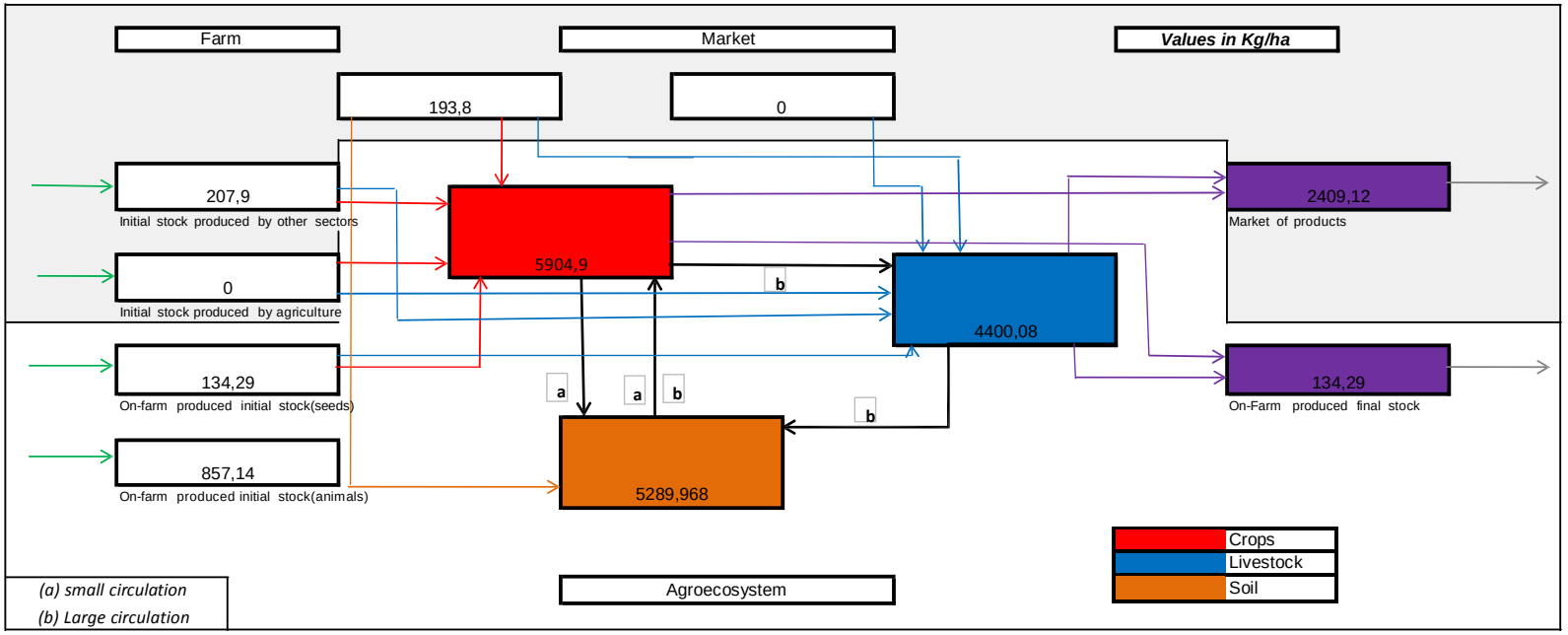

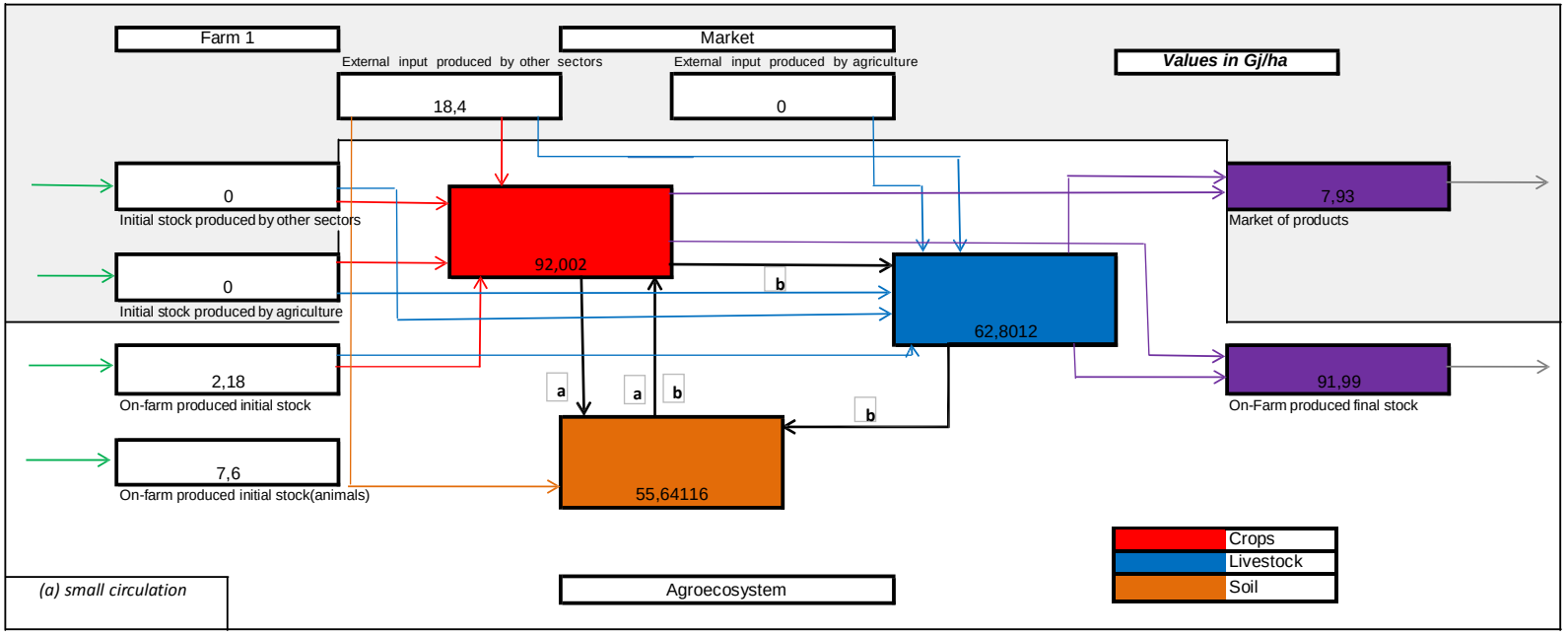

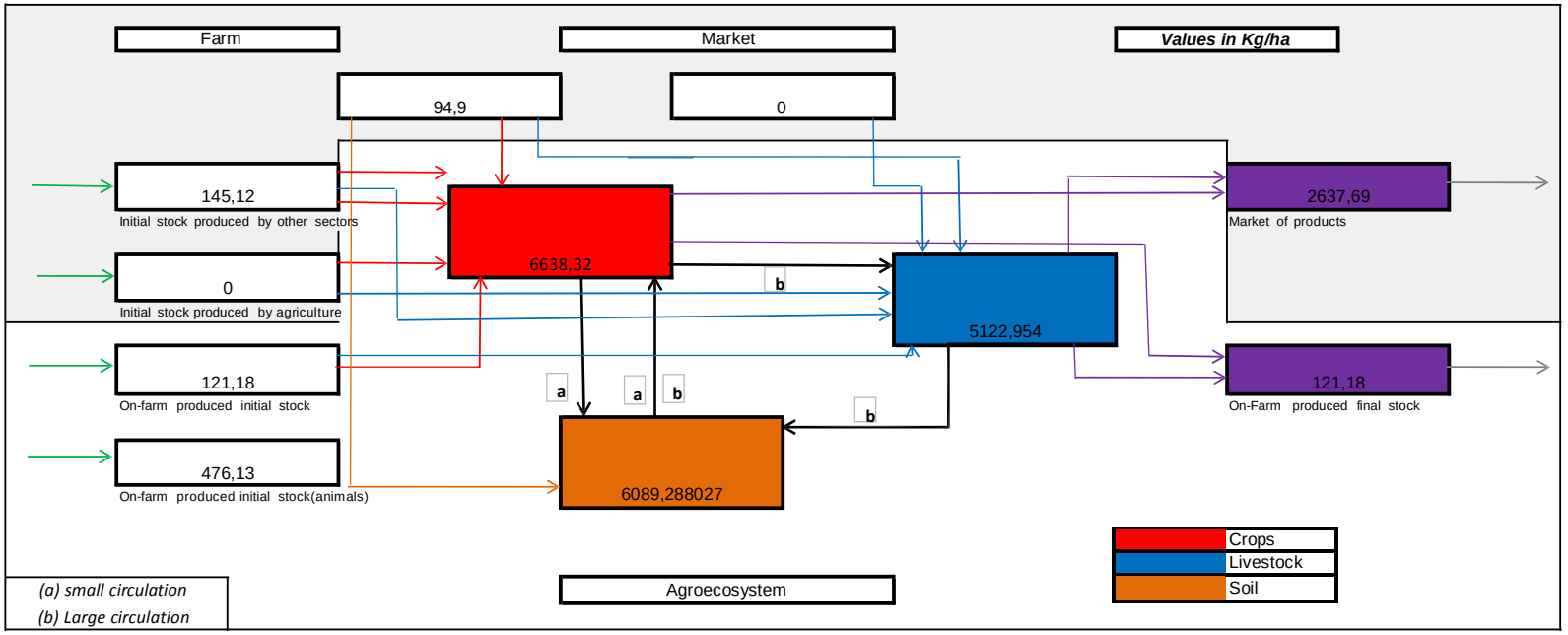

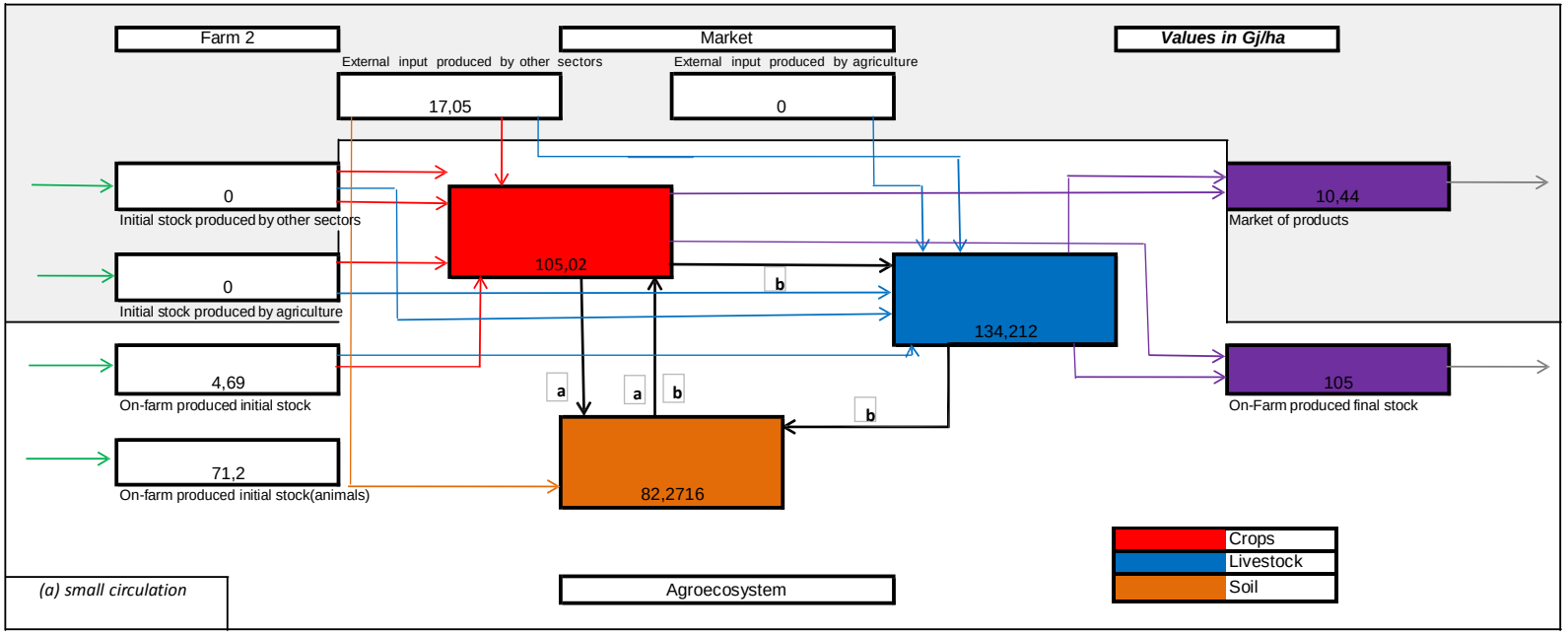

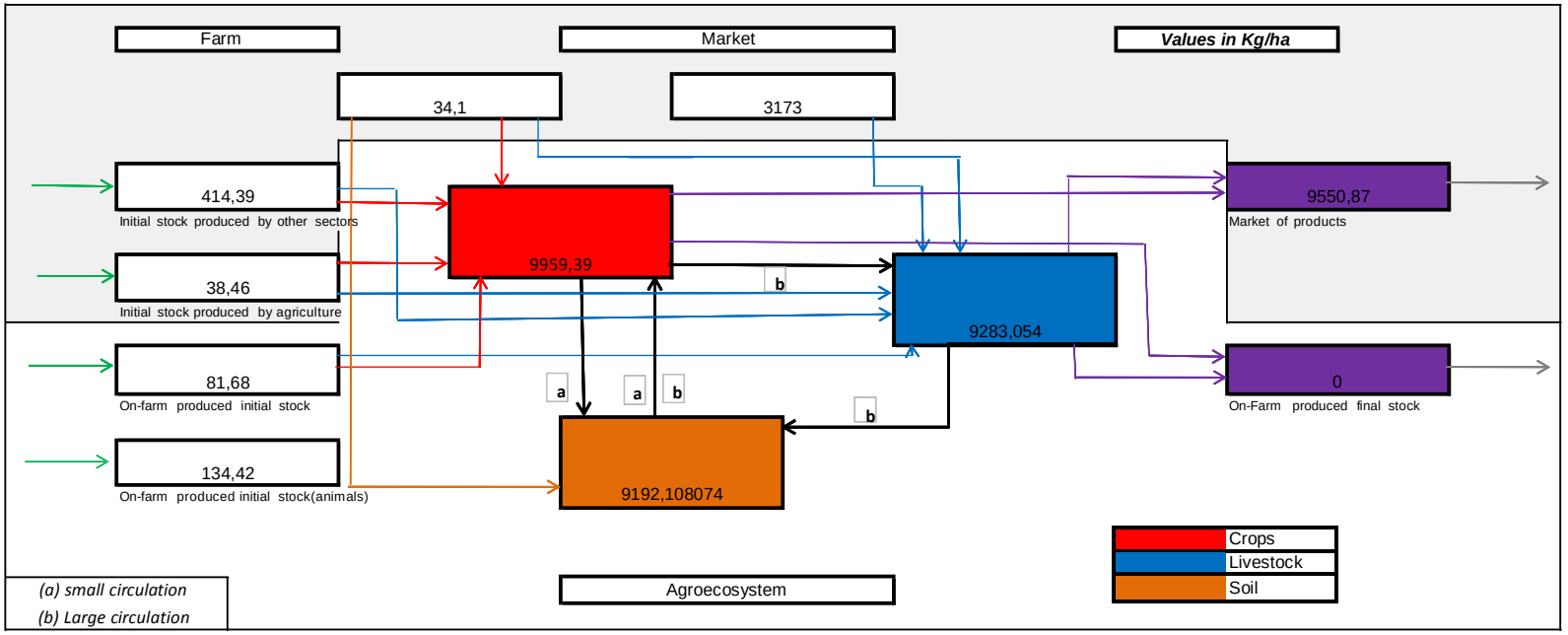

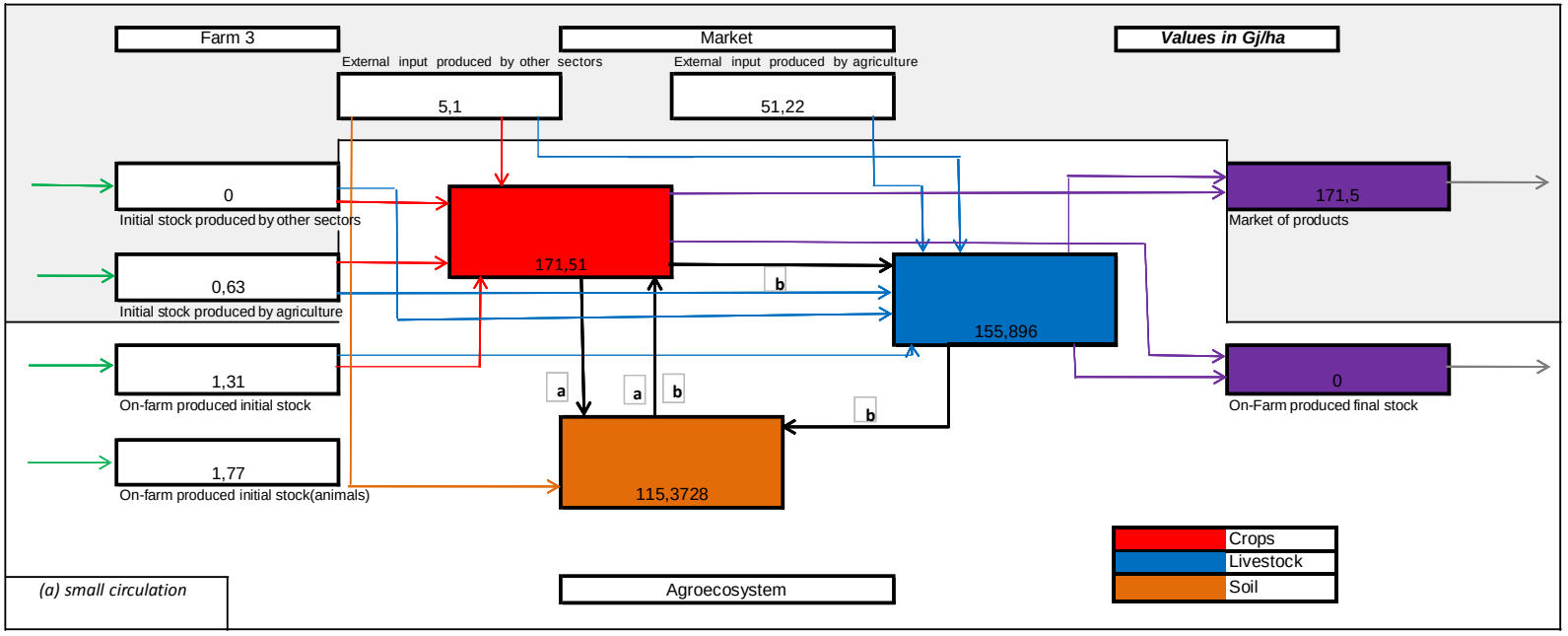

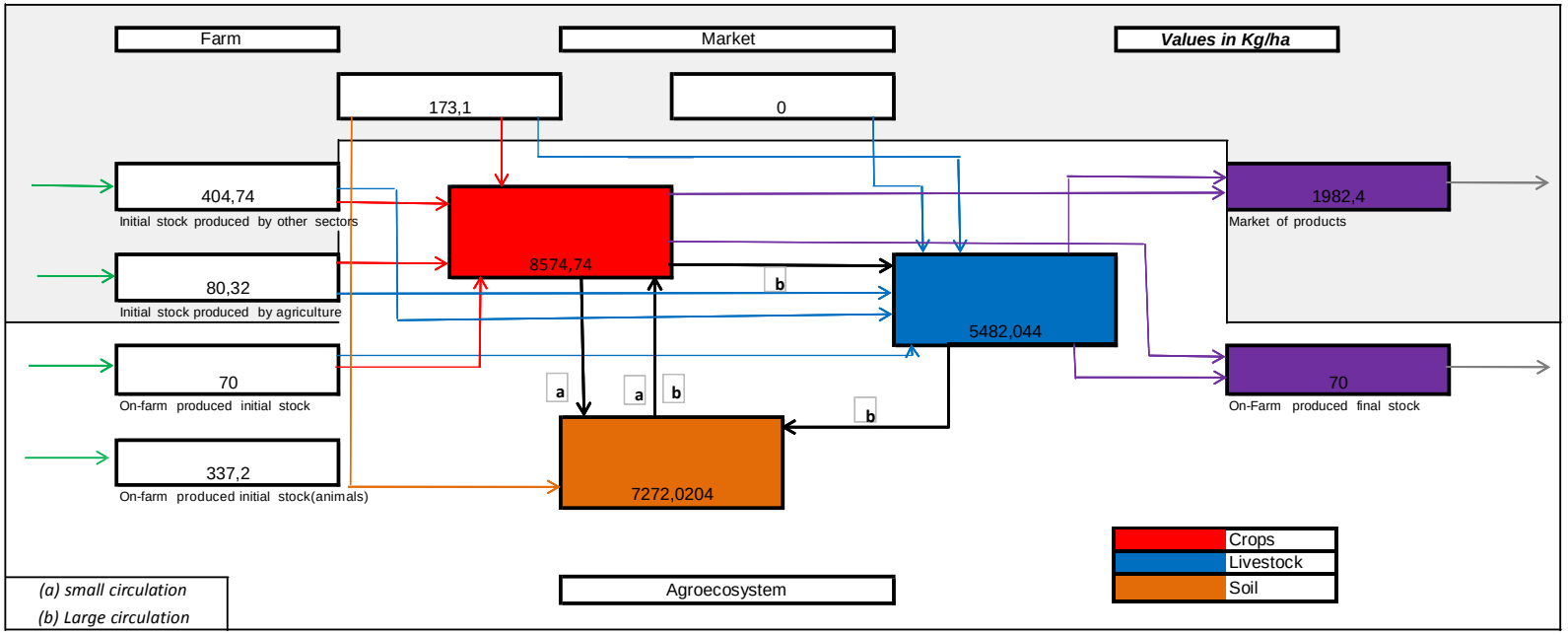

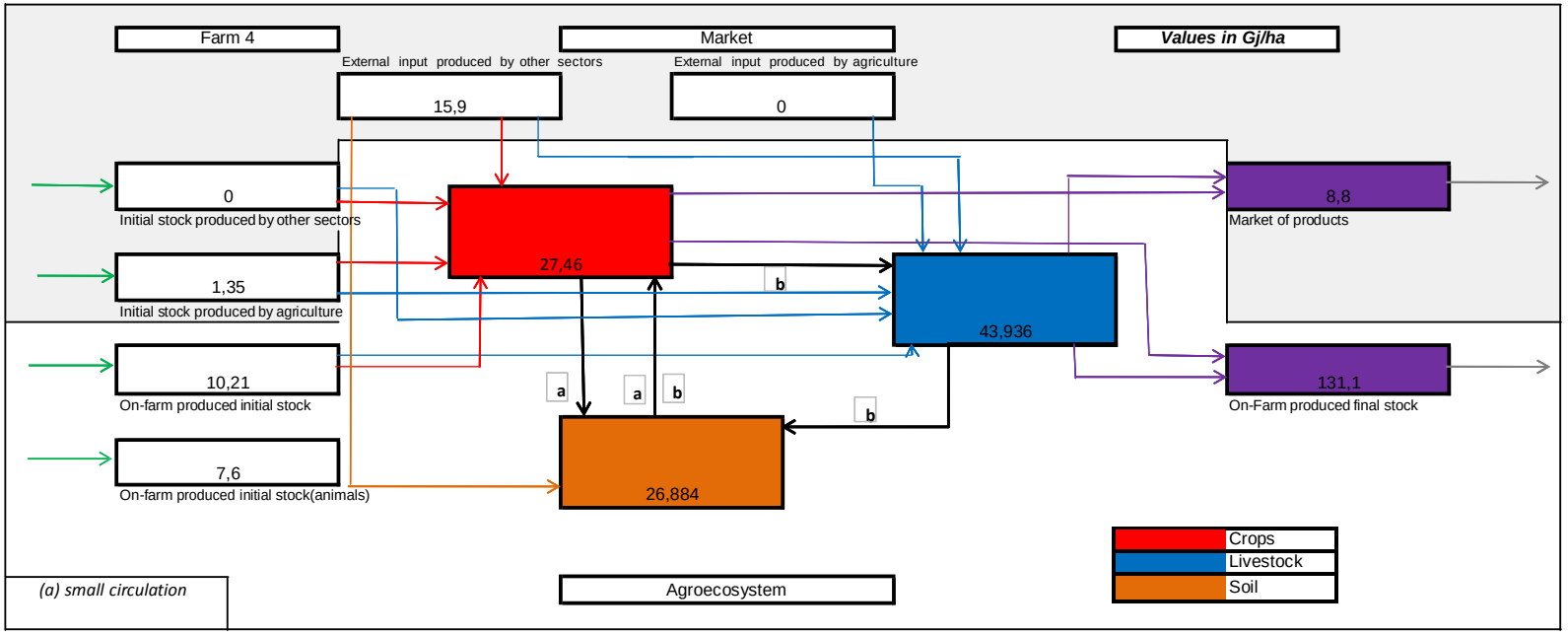

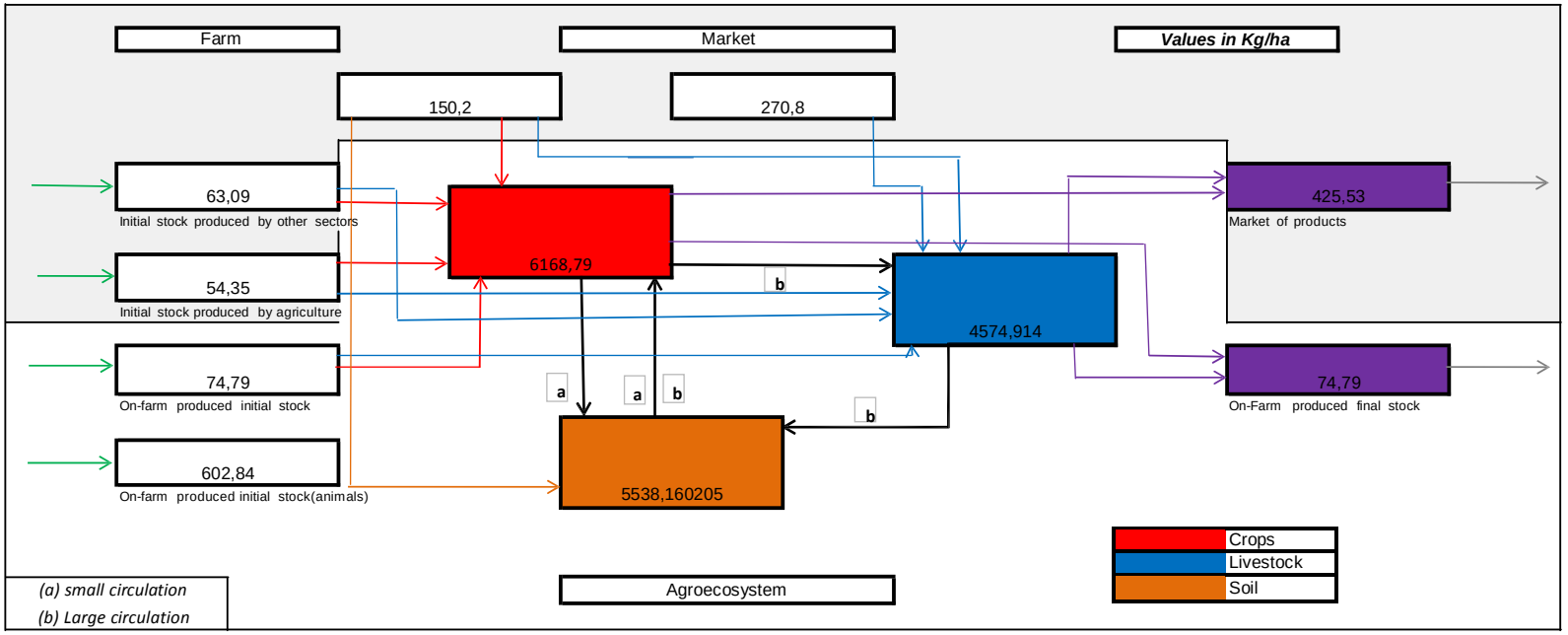

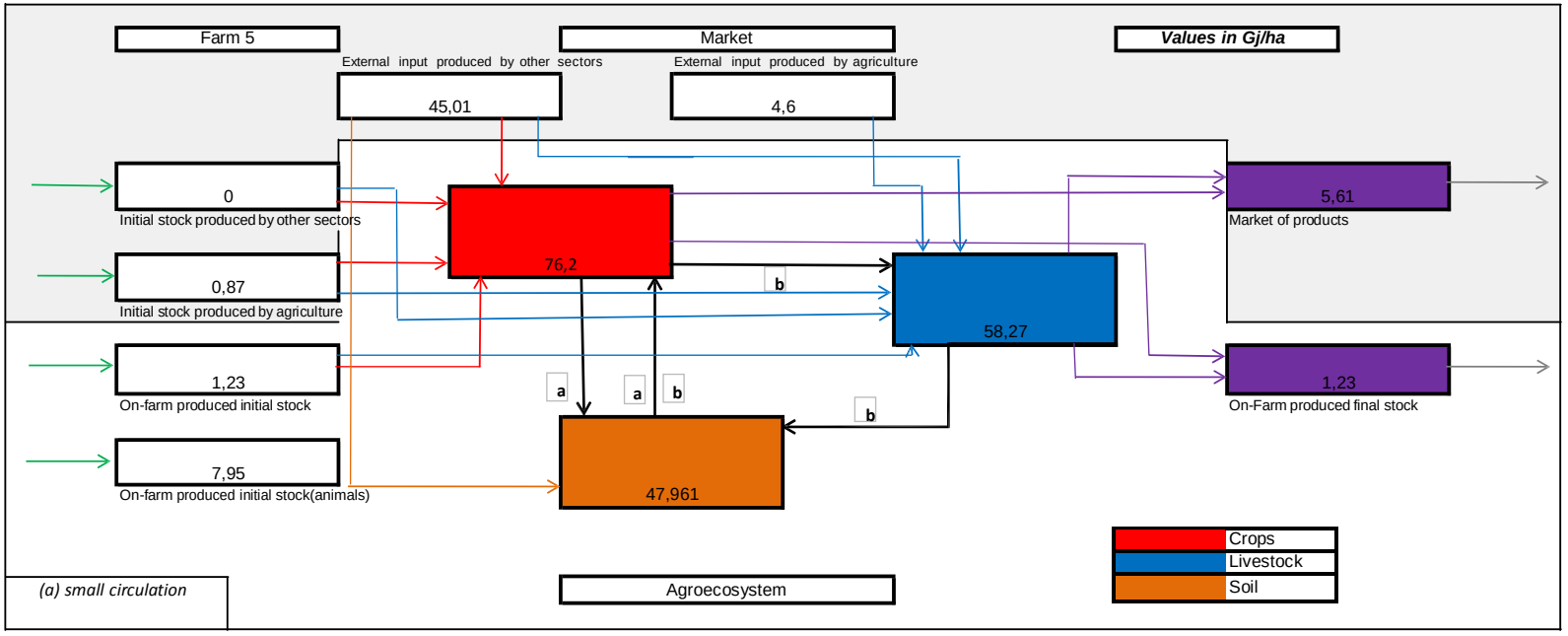

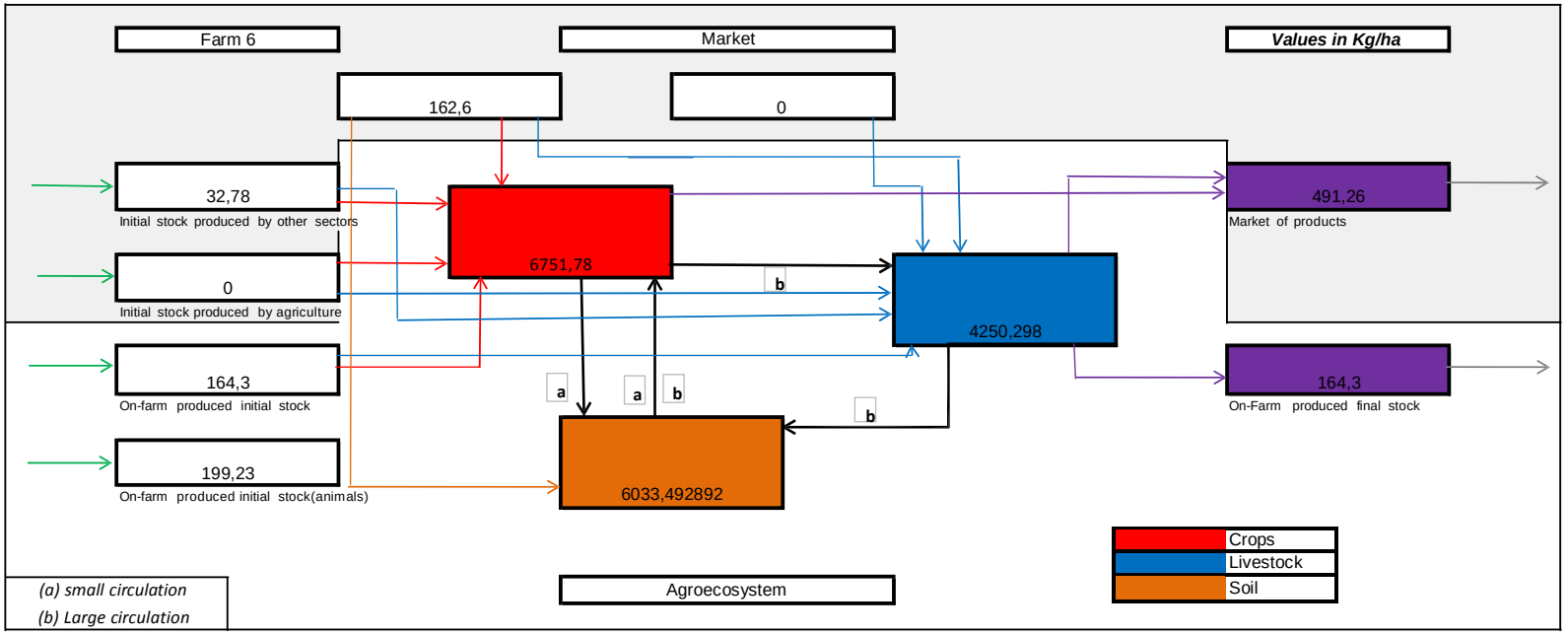

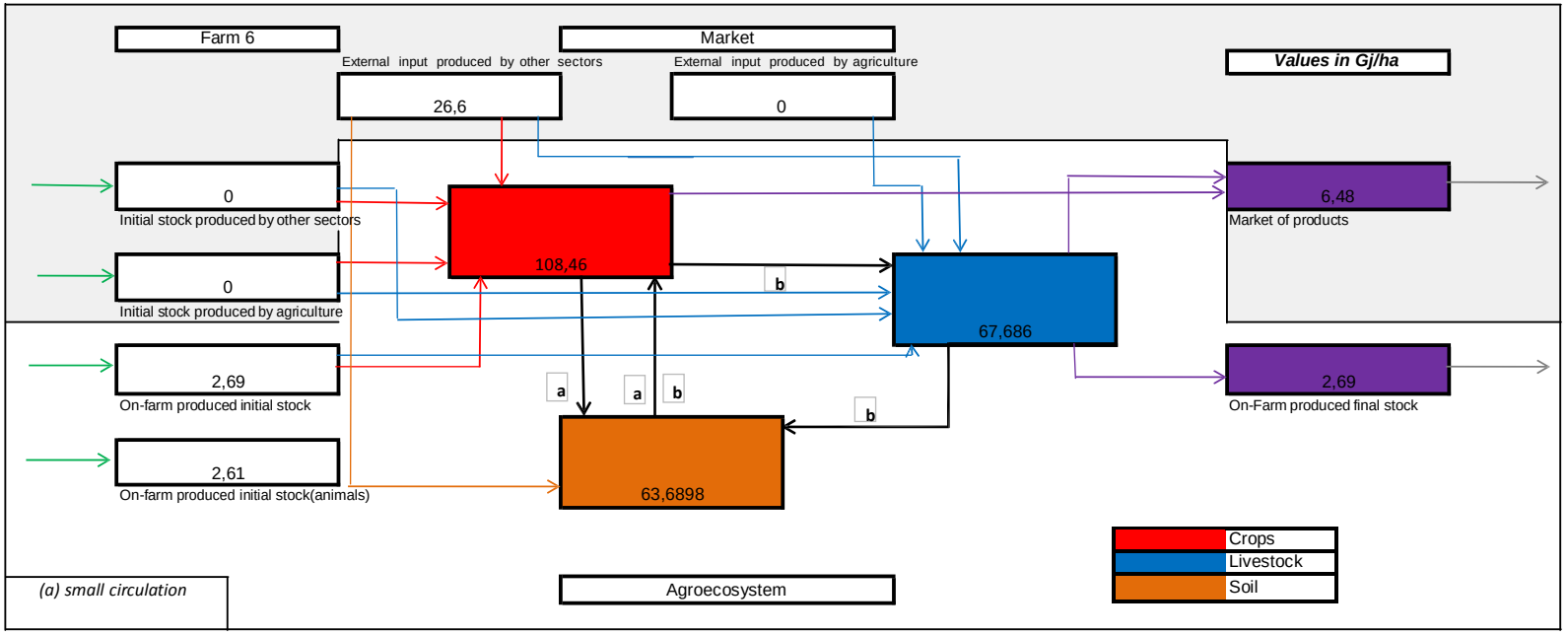

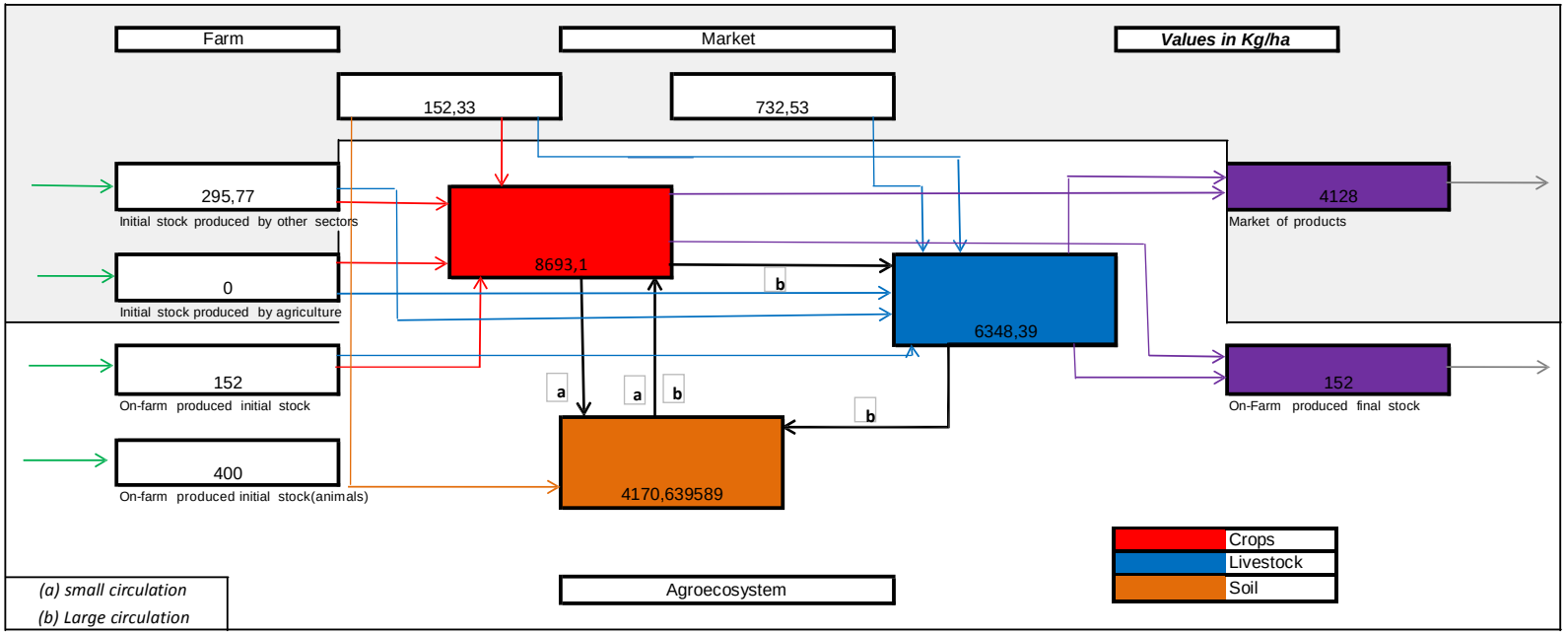

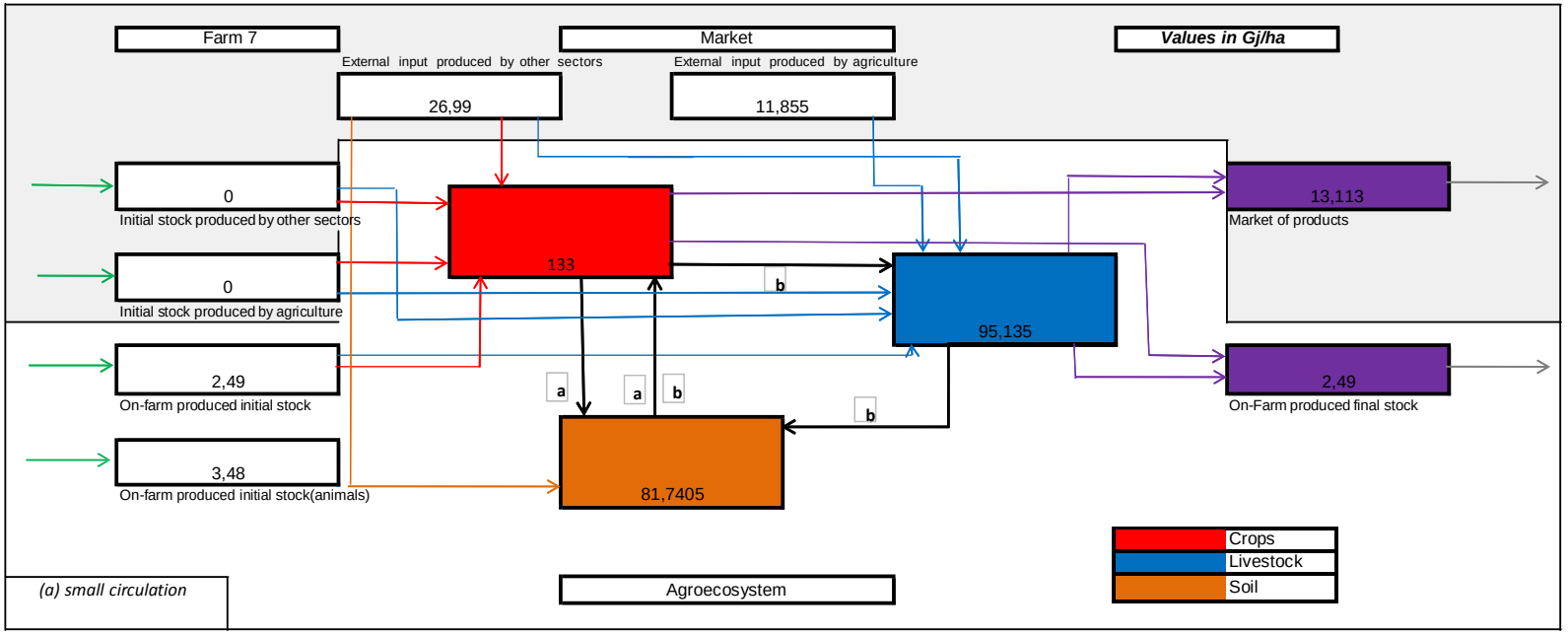

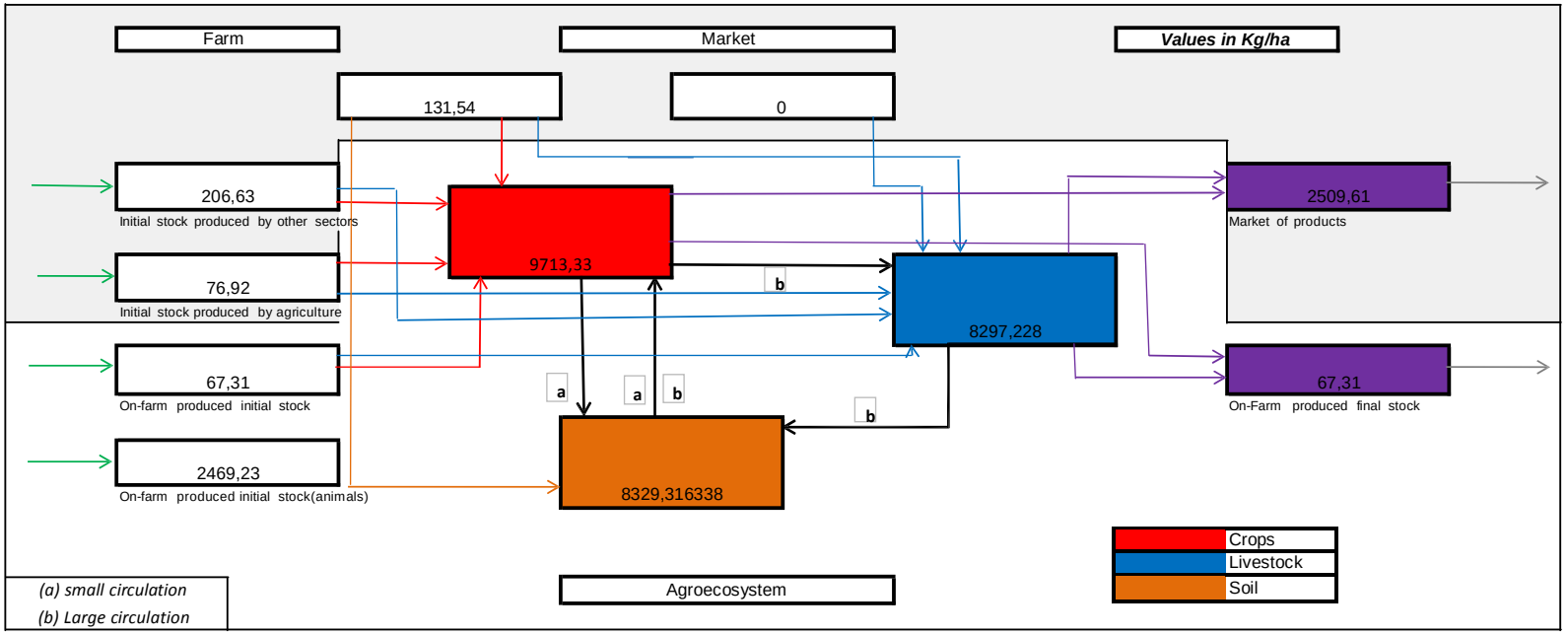

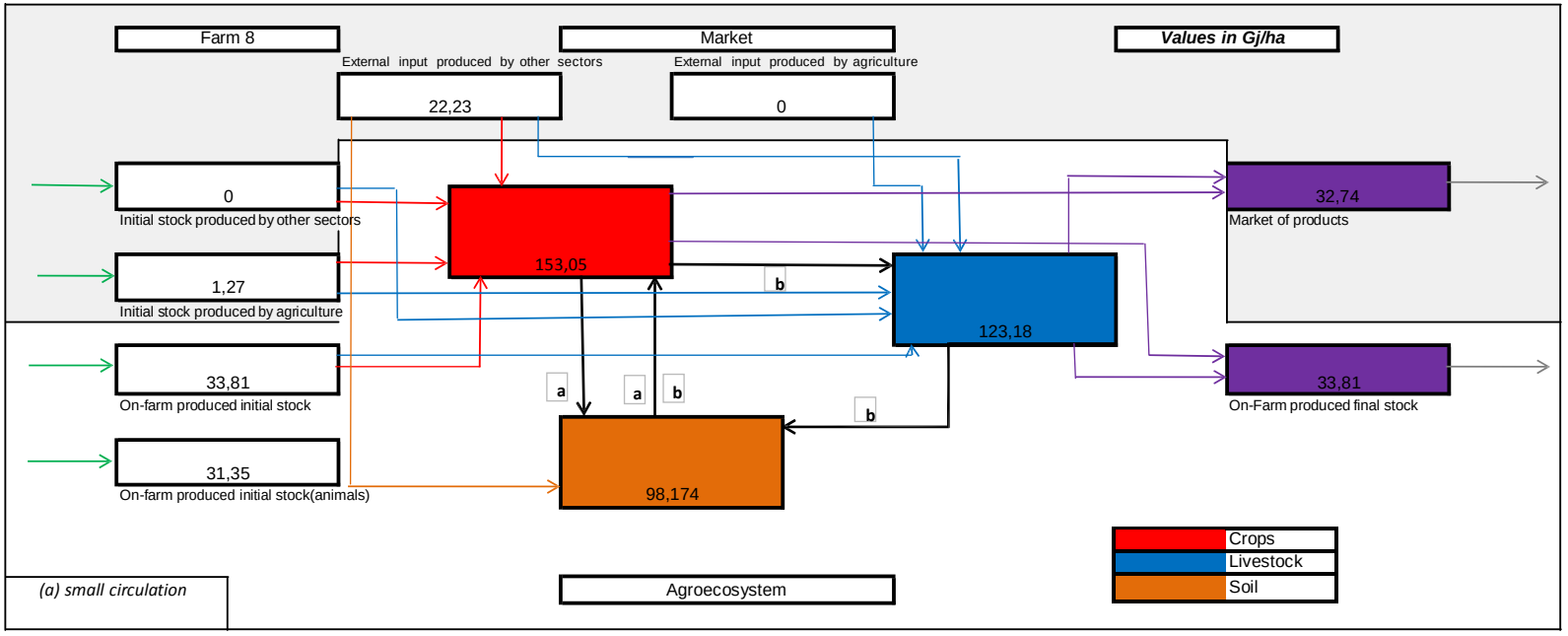

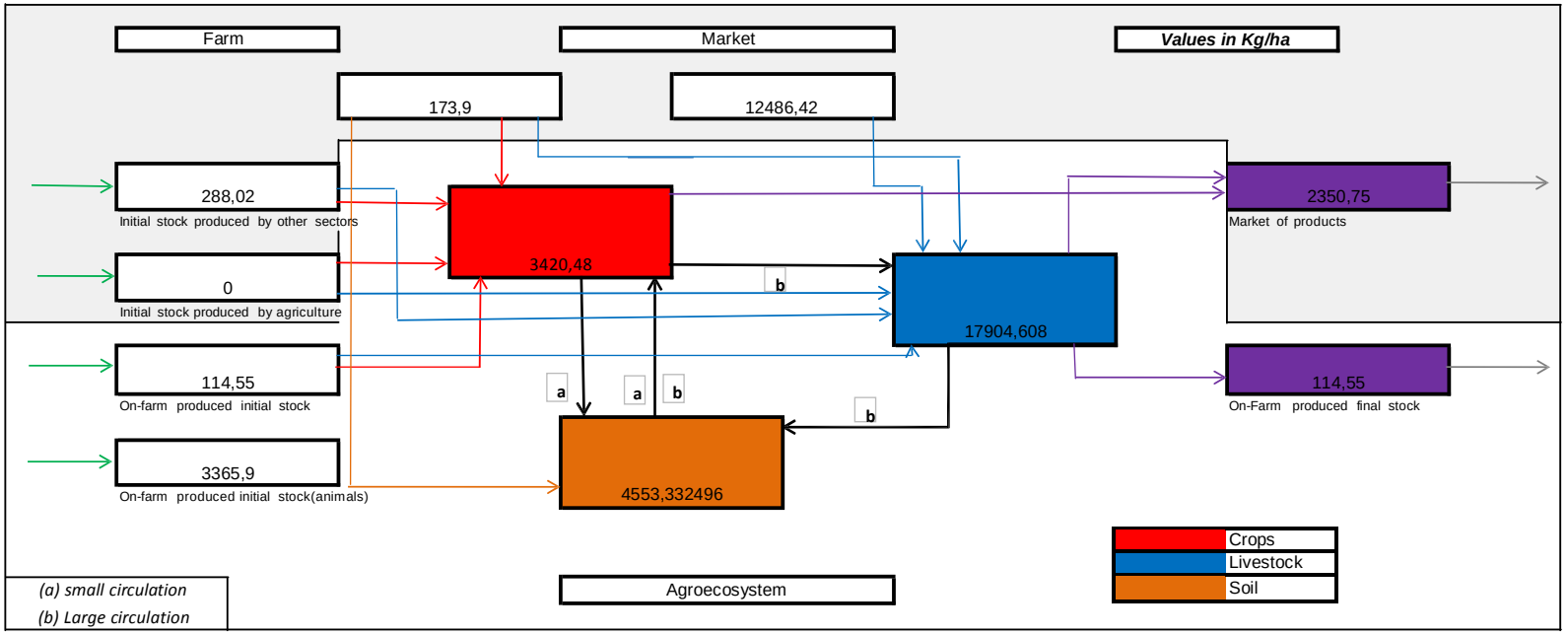

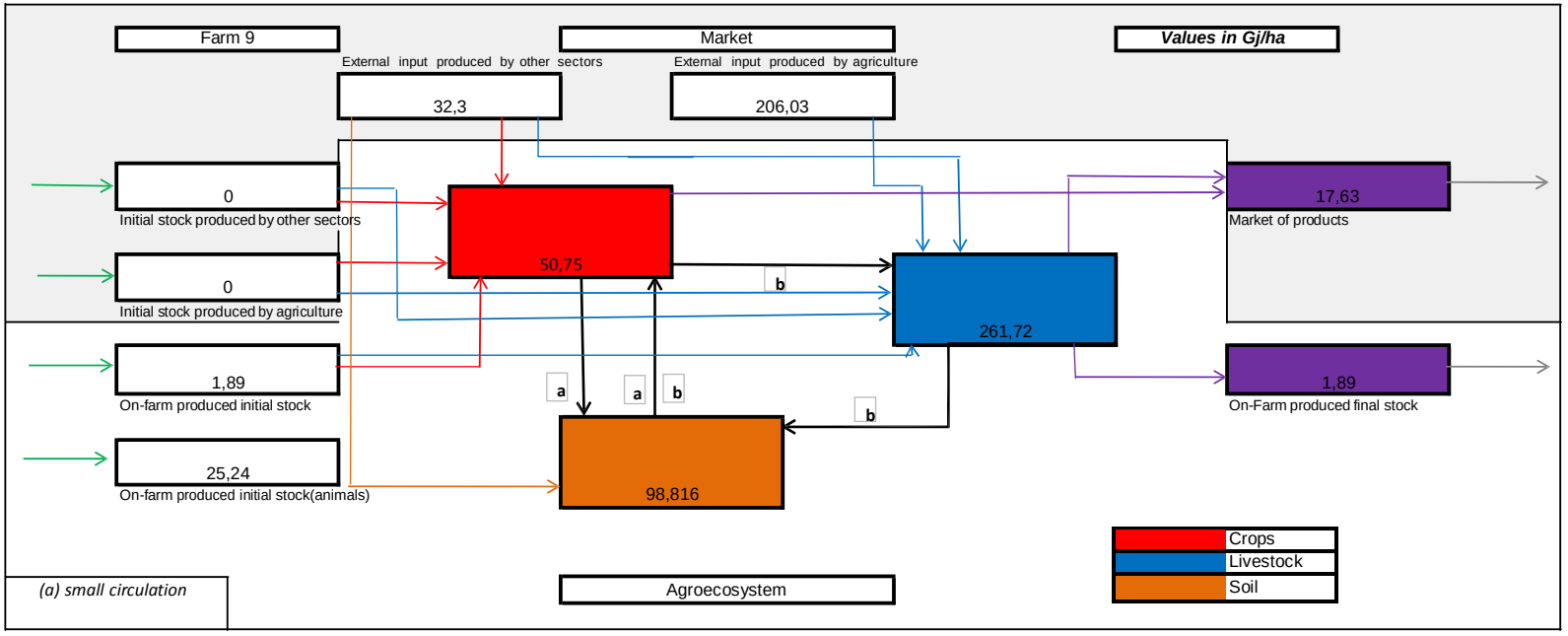

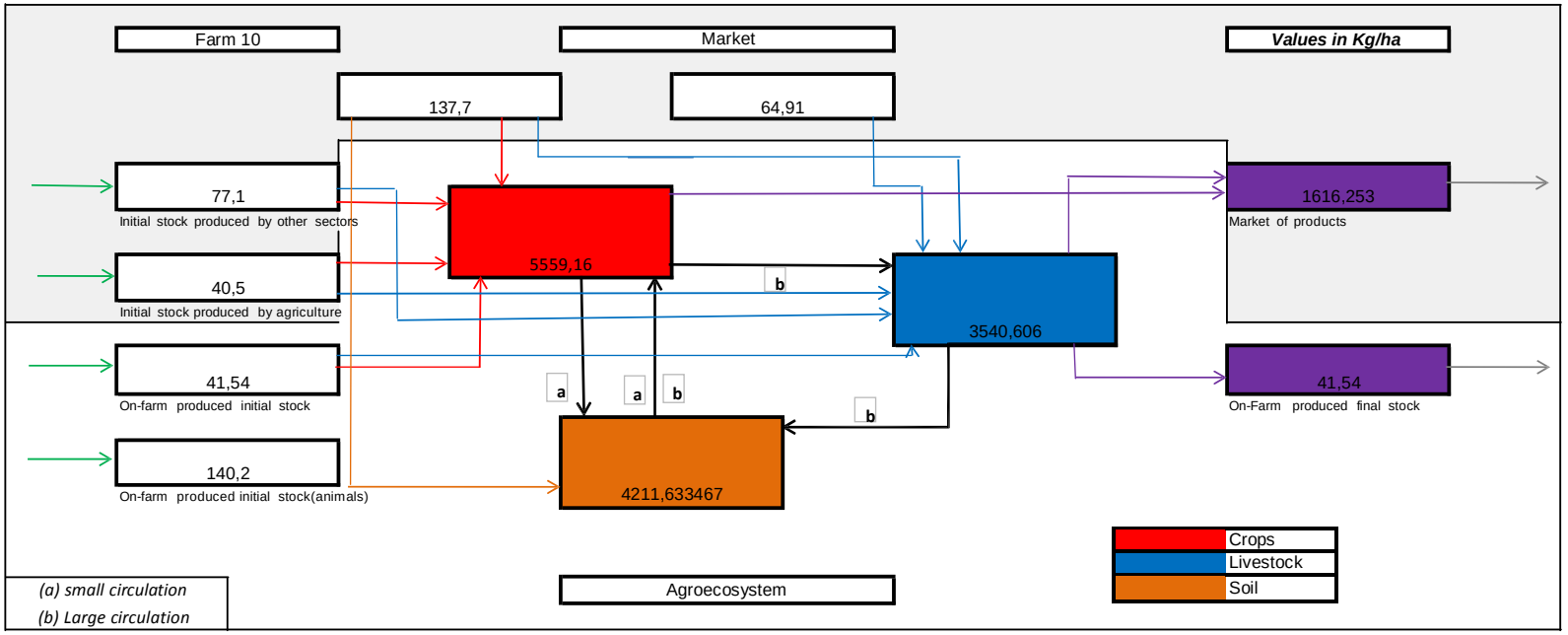

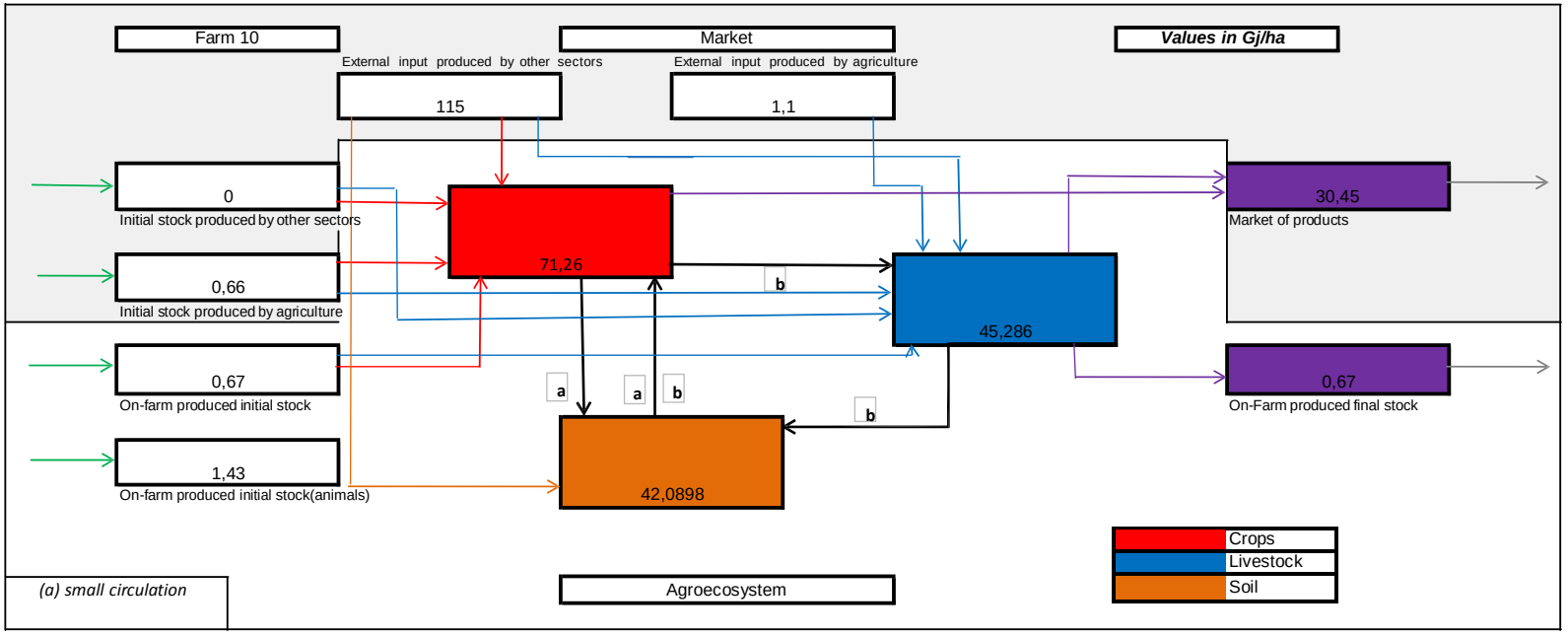

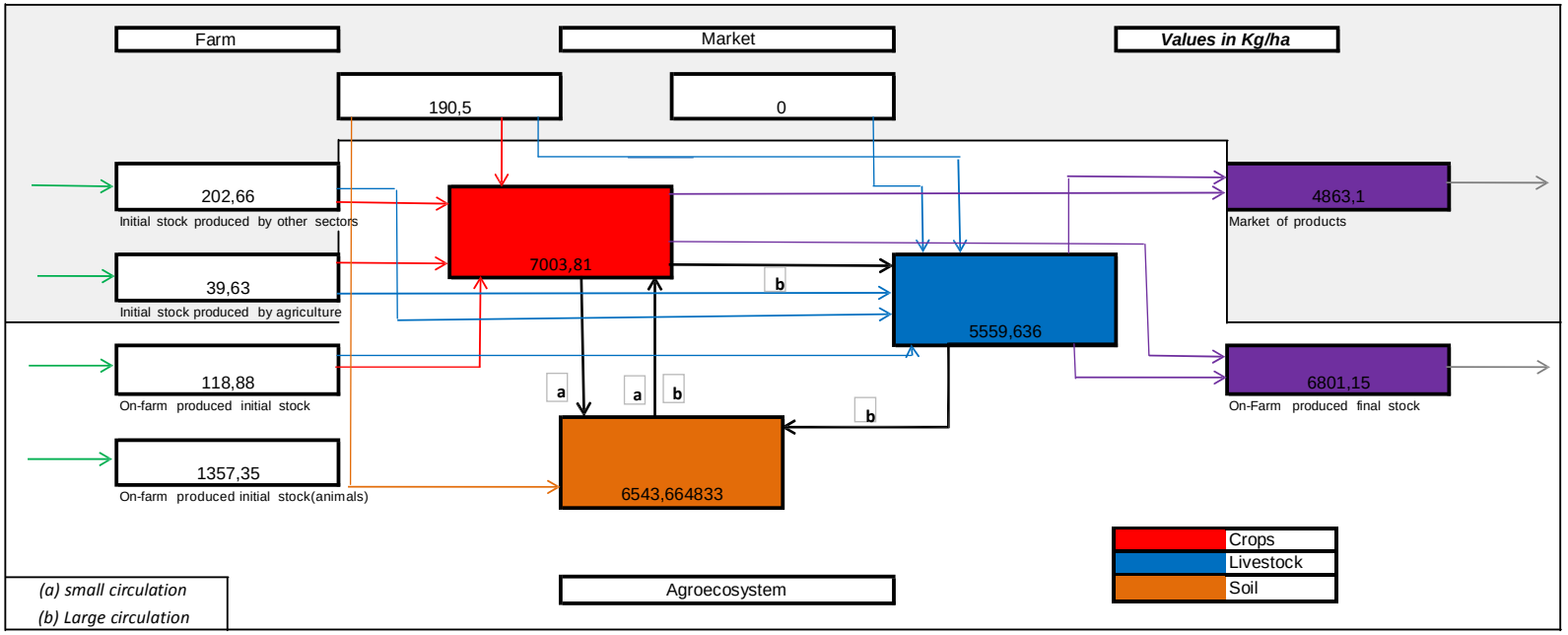

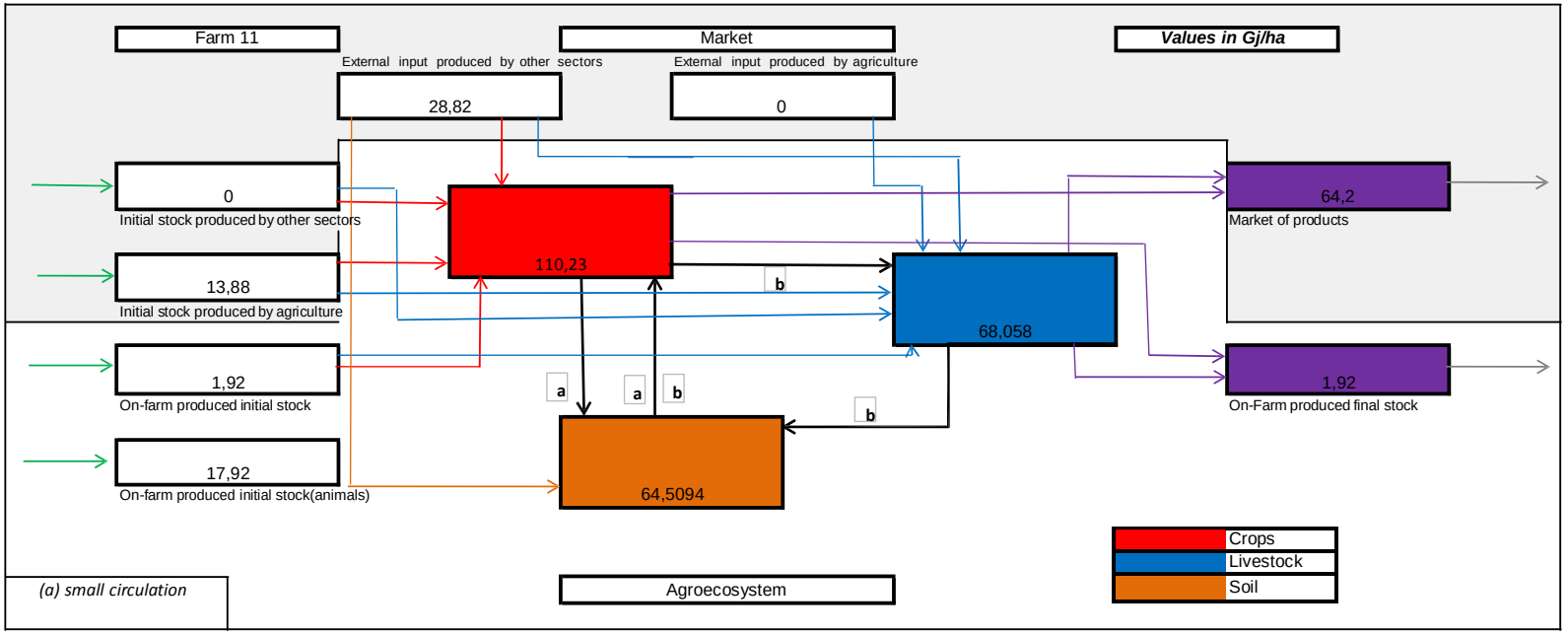

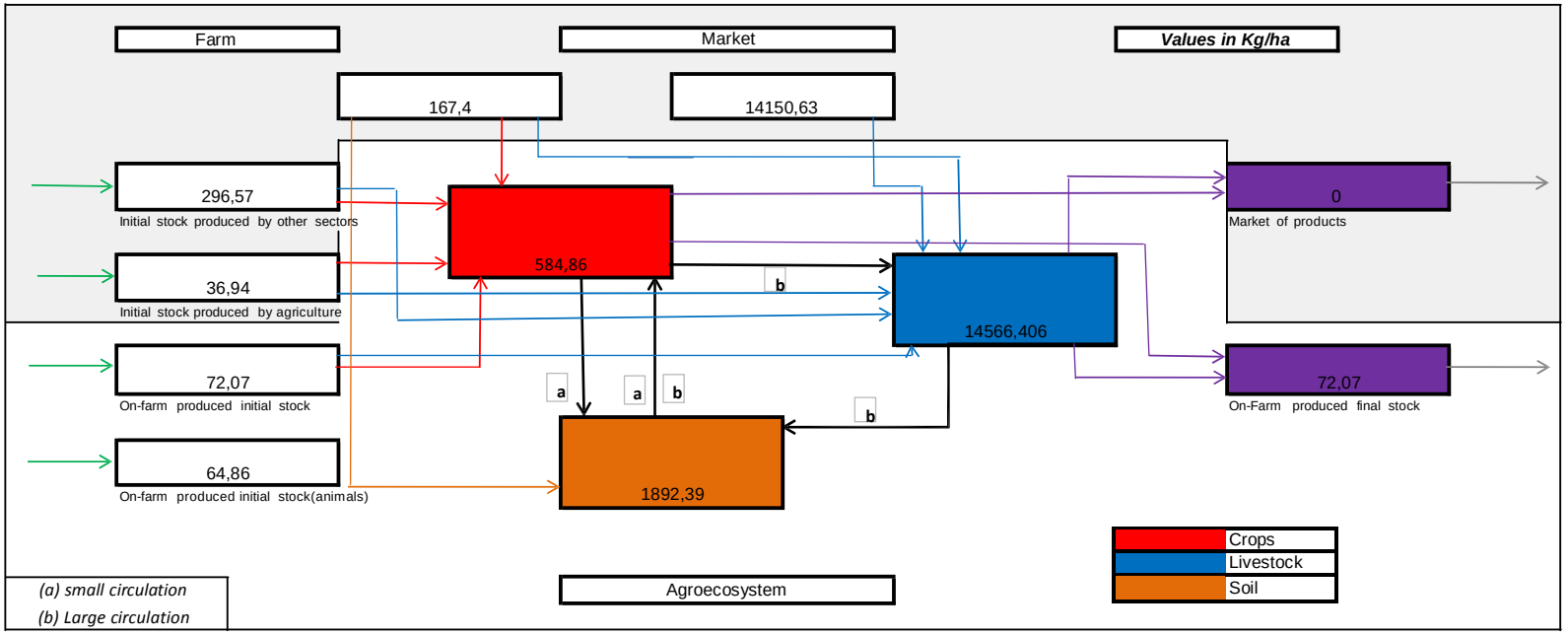

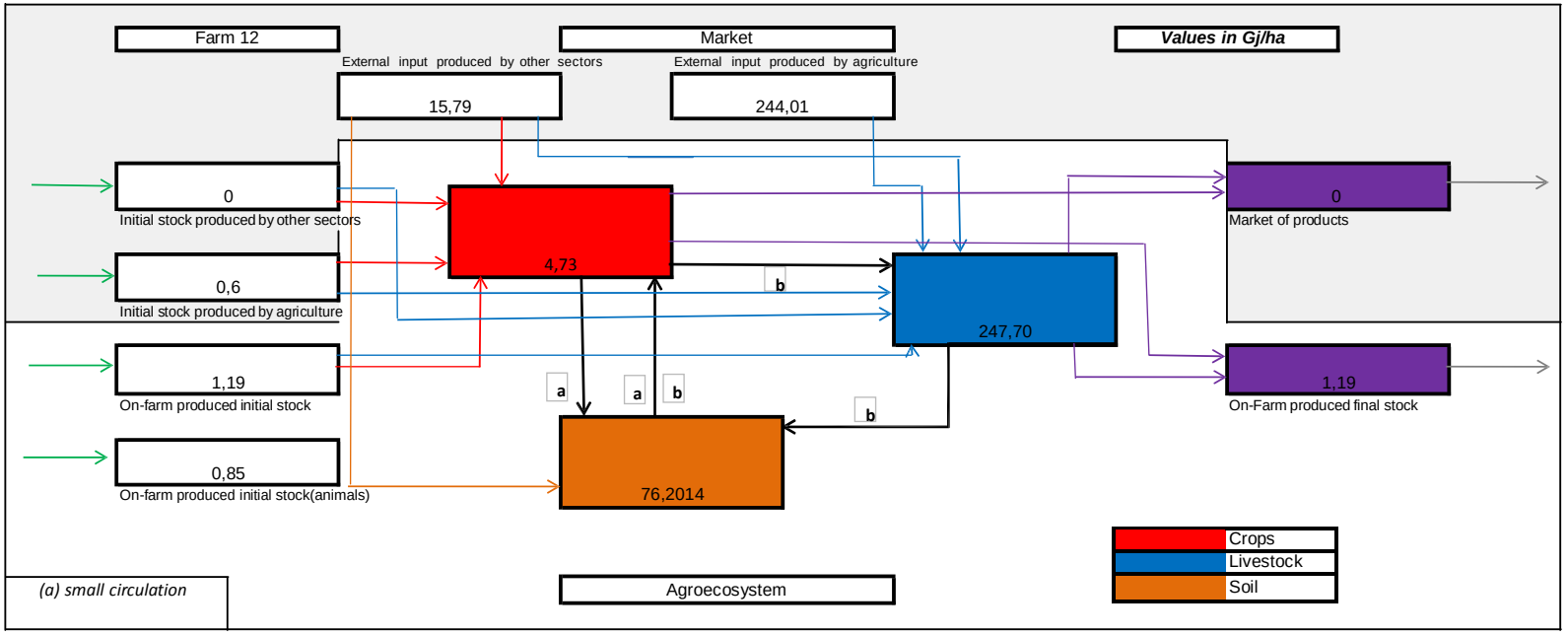

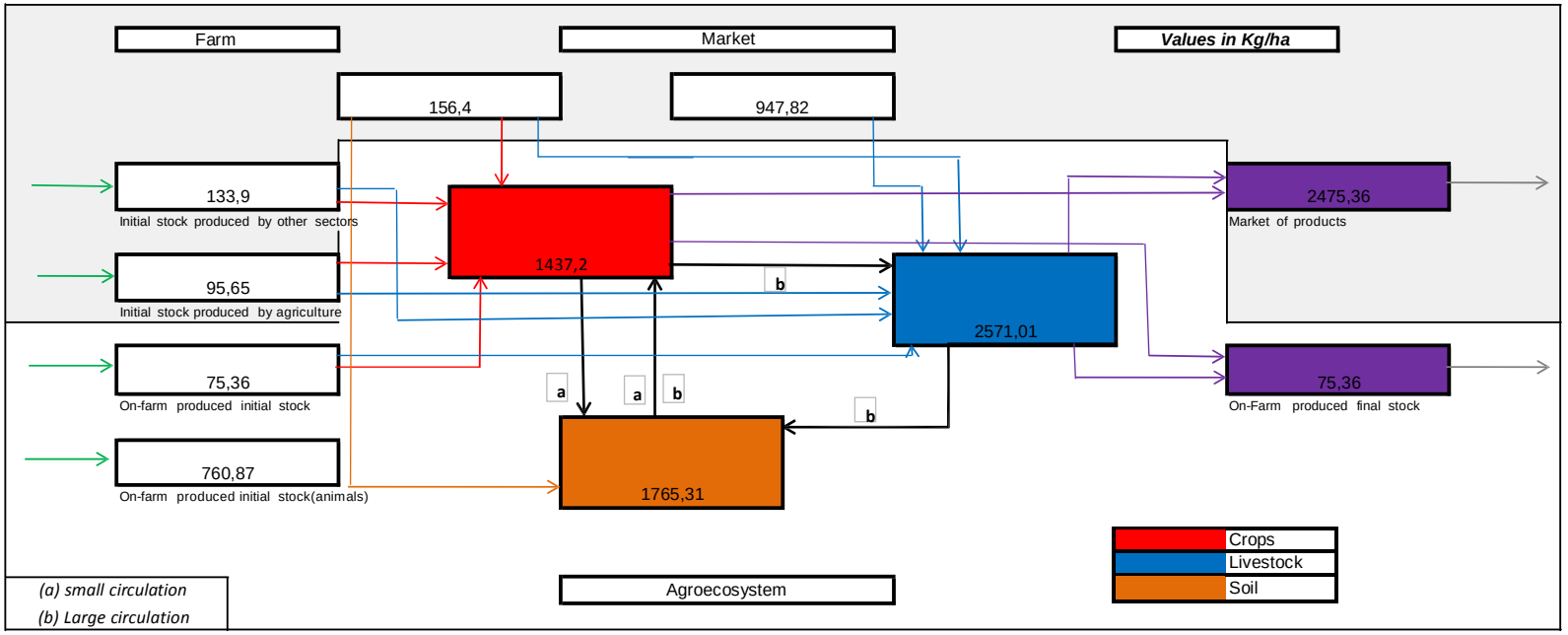

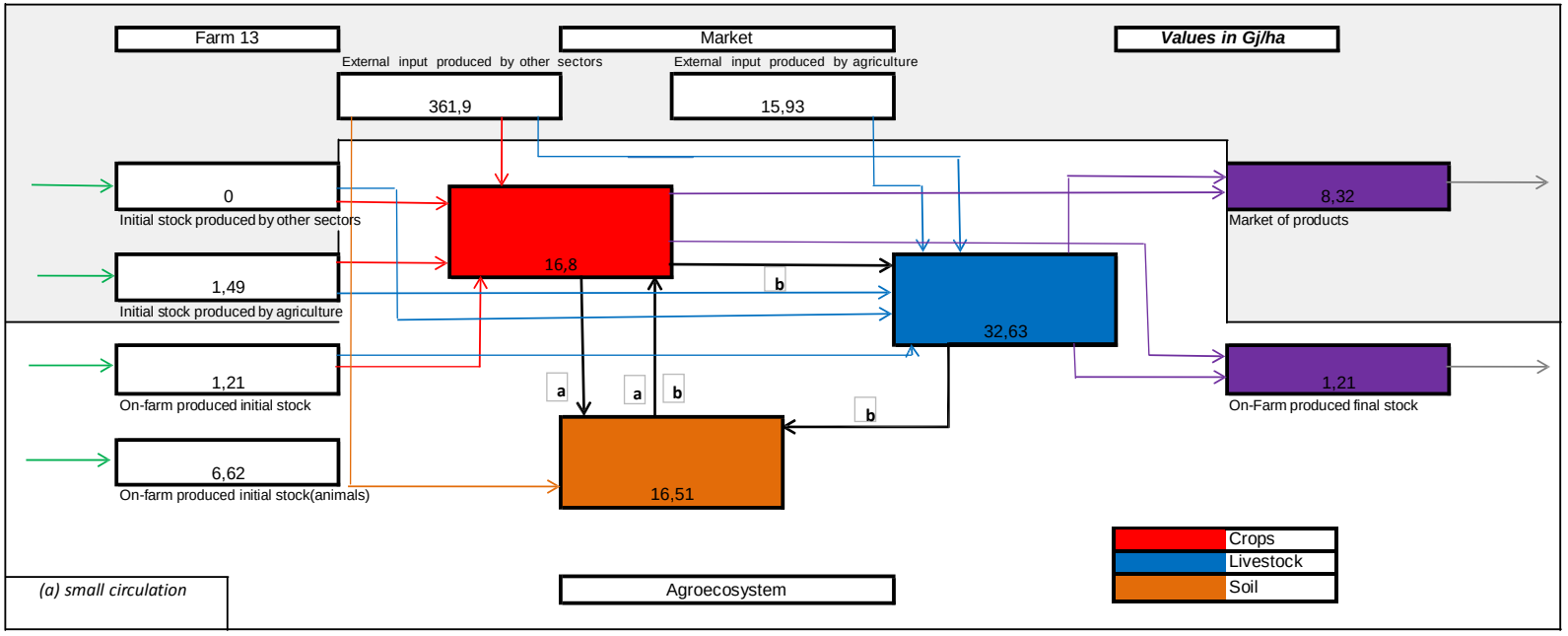

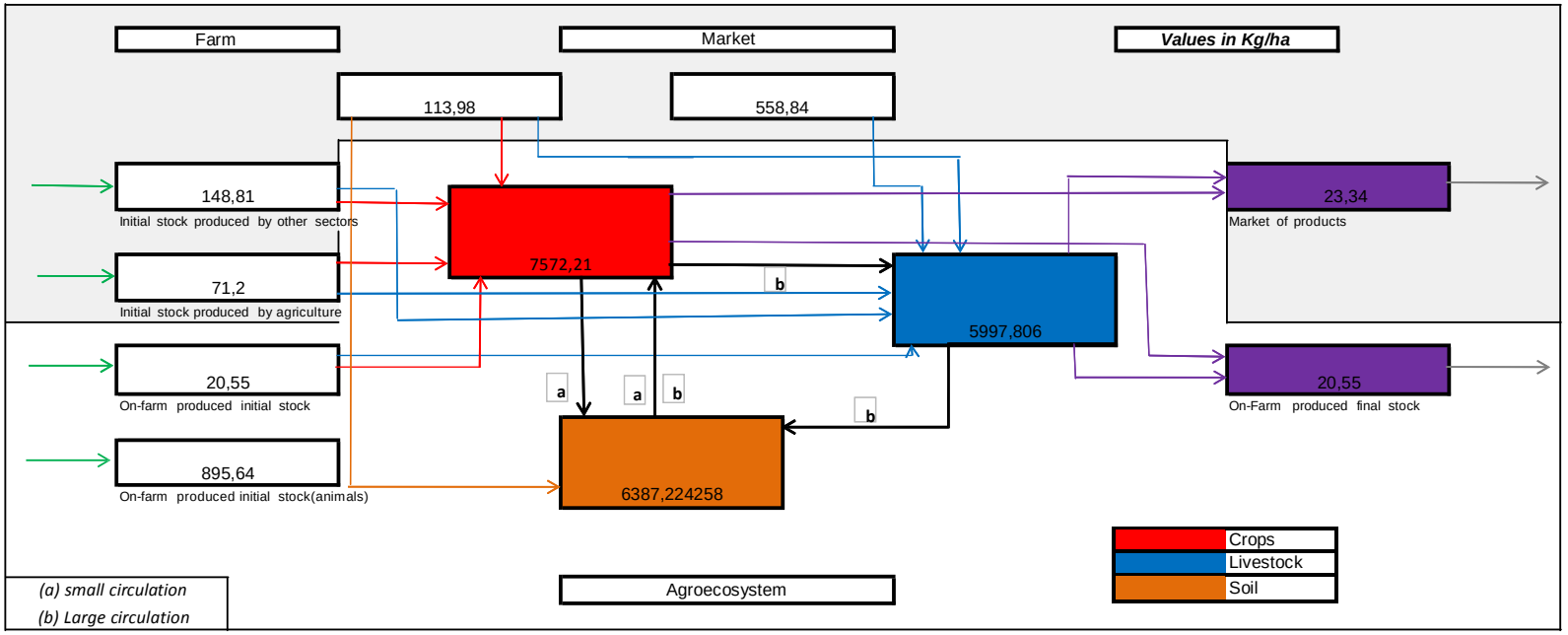

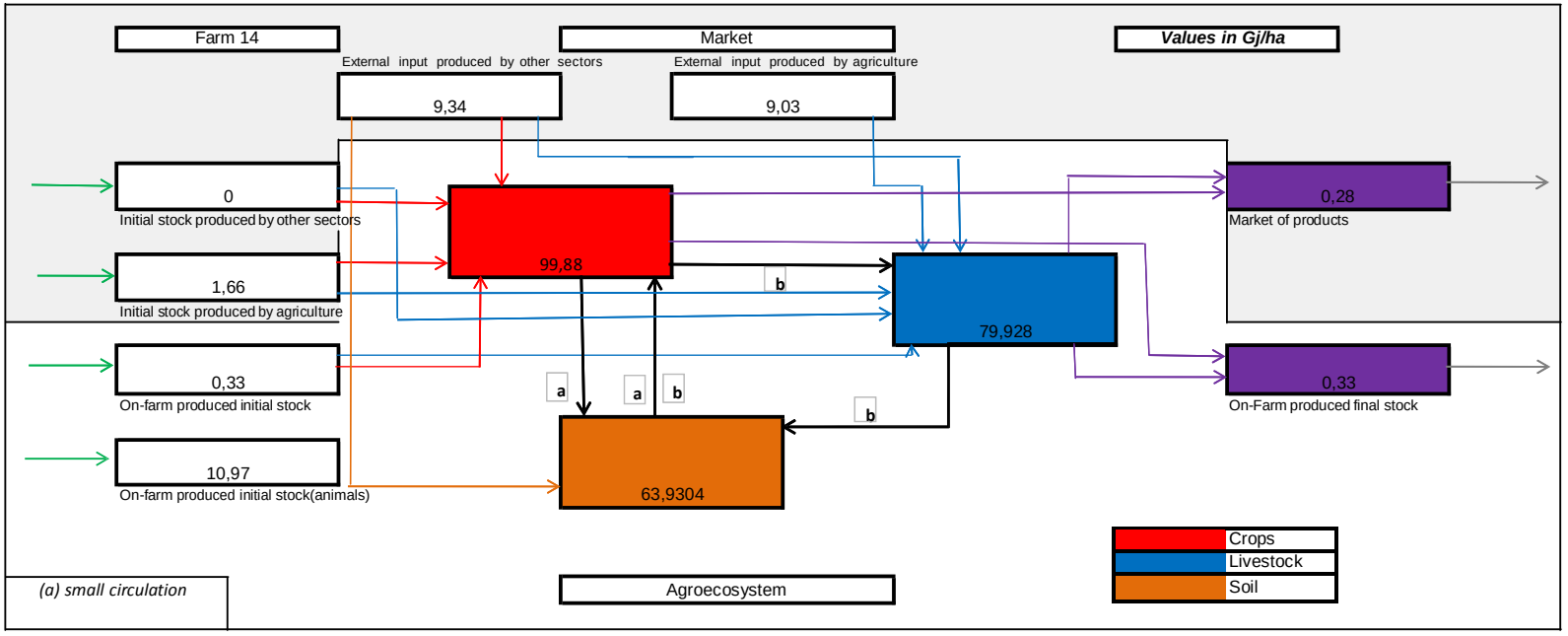

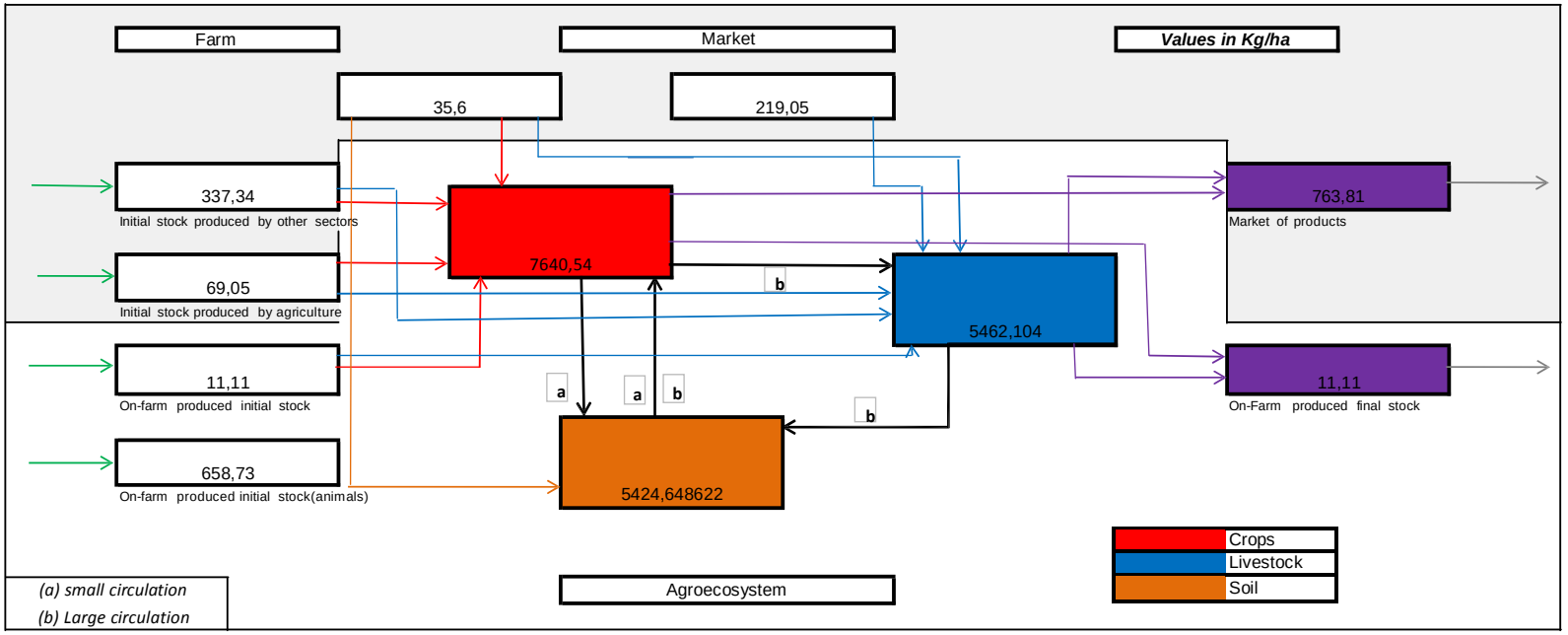

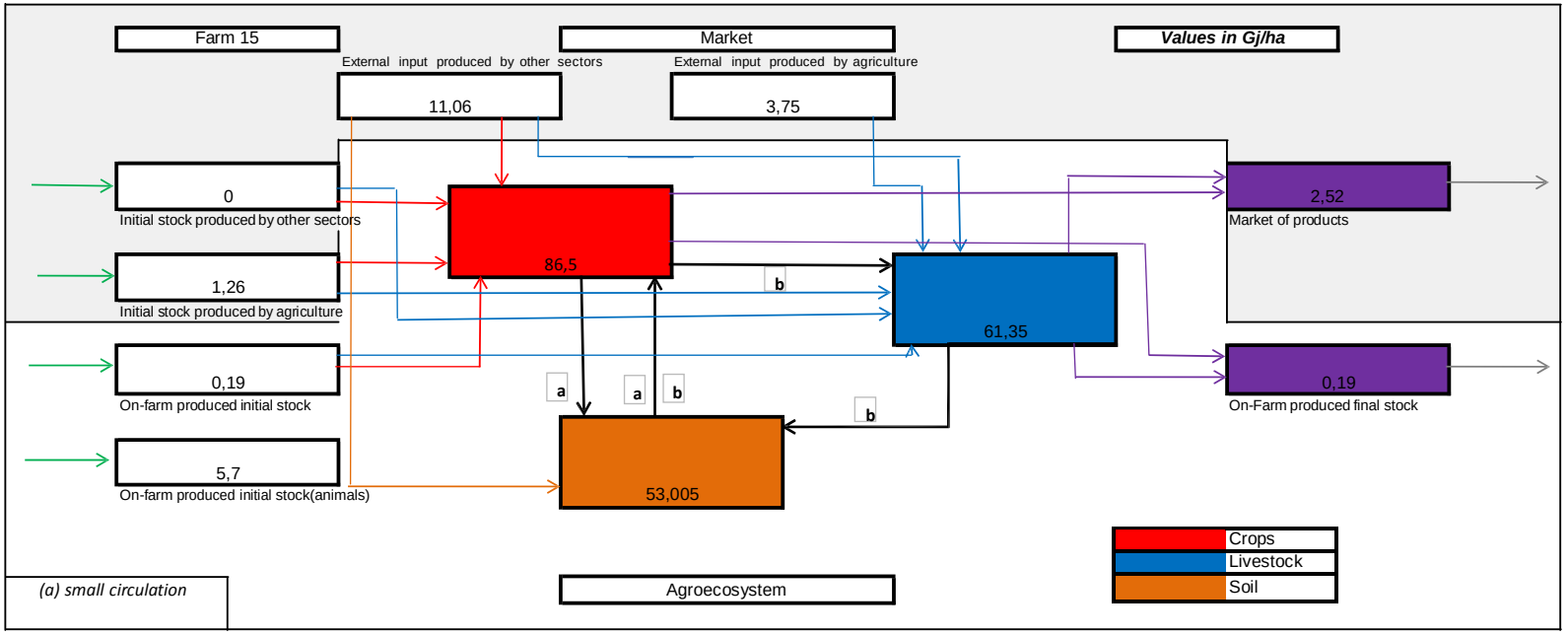

RESUMEN

Este trabajo final de carrera fue llevado a cabo en la Universidad Nicolaus Copernicus bajo la supervisión de tutores de la facultad de ciencias de la tierra y medioambiente. En él, se trata de reflejar el estado de la agricultura polaca.

Para su realización fue necesaria la colaboración de estudiantes polacos, quienes nos traducían ciertos datos que sólo aparecían en su lengua. El trabajo consta de una parte teórica en donde se basa en publicaciones y demás fuentes de datos y otra parte en donde se realizan modelos prácticos gracias a datos recogidos directamente de agricultores.

En la primera parte podremos observar datos sobre varios aspectos de la agricultura polaca como pueden ser: tipos de explotaciones, tipos de explotaciones según la producción, tipo de mano de obra empleada, características del suelo, características de recursos como el agua, energías renovables, etc… Se trata de describir de una manera general la agricultura polaca entrando en detalles no menos importantes como la formación de los agricultores o la tendencia de las edades de estos mismos.

En esta primera parte también será posible descubrir cuáles son los cultivos de relevancia en Polonia y comparar producciones con otros estados miembros de la Unión Europea. Se podrá observar que Polonia es un productor a tener en cuenta en varios cultivos a nivel mundial.

En la segunda parte se realizará una parte más técnica en donde se recogerán datos de un número de explotaciones mediante formularios y entrevistas con los propios agricultores. Gracias a estos datos, podremos poner en marcha un modelo por el cual podremos evaluar el flujo de materia y energía y evaluar en general los números totales de cada explotación.

Estos modelos nos permiten observar si una explotación es sostenible o no además de poder ver detalladamente los inputs y los outputs de cada una. Estos inputs podrán ser provenientes de la producción del año pasado o comprados, es decir, de fuera de la explotación.

Del total de los datos se tratará de comparar unas explotaciones con otras y se harán recomendaciones subjetivas sobre lo que se puede estar haciendo mal. Como el propio título del proyecto dice, es un análisis y descripción de la agricultura polaca, centrándose en la región Gmina Czernikowo.